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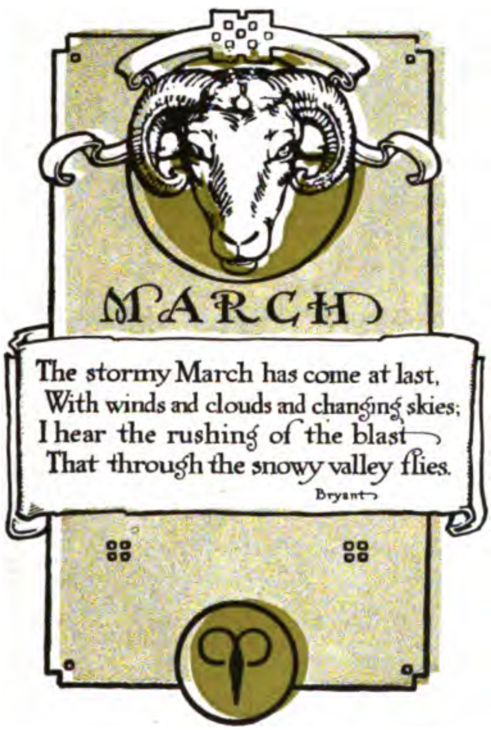

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WHAT THE LUMBERMAN FINDS.

WHAT HE LEAVES.

Nothing could better show than do these two photographs, the absolutely reckless and wanton methods practiced today in the cutting of timber in this country.

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THE TECHNICAL WORLD MAGAZINE

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WHO OWNS THE EARTH AND HOW DID THEY GET IT?

By Henry M. Hyde.

III. LOOTING THE FORESTS

FREUDENSTADT is a town of seven thousand people in the Black Forest region of Germany.

Chisholm was a town of six thousand in the Big Woods country of Minnesota.

Every year, from the tall black pine trees which grow in ordered regiments on the six thousand acres of publicly owned land about Freudenstadt a regular crop of lumber is cut which pays all the expenses of the city government—Mayor, Aldermen, Police and Fire Departments. And that crop will go on forever. The thrifty people of Freudenstadt may de-

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vote their whole attention to their thriving iron and chemical industries, knowing that the beautiful and beneficent forest will pay all the cost of their municipal activities.

Every year—until this—greedy private corporations have sent their hordes into the country about Chisholm to loot the great pine woods, leaving behind them a trail of ruin and desolation and piling up the dry slashings like kindling-wood ready for the match. Every fall the patient people of Chisholm have gone to bed with the acrid smell of burning pine in their nostrils, fearing lest before they woke the forest might take its fiery revenge. Last summer it came. For weeks thick clouds of smoke lay over the town. Then on a Saturday night the hurricane of flame swept down and burned Chisholm to the ground. So sudden and dreadful was the onslaught that domestic animals dropped dead in the streets, overcome by the heat. Men carried out their sick on beds and rushed them through the smoke and flying embers to places of temporary safety. One woman died of fright. In the morning more than five hundred families were homeless.

Freudenstadt is a town without taxes. The forest pays them. Chisholm is a town without homes. The forest destroyed them.

That tells—in little—the story of the forest policy of the United States and its results, as compared with that followed in other civilized countries.

Every year since 1870 an average of fifty people have been burned to death in the United States by forest fires—a total of more than 2,000 innocent people tortured to death that a few score lumber companies may enjoy "individual free-

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dom of action" in "the handling of their own private property." And that is only one bright scarlet stain on a thick black record of permanent and irremediable wrong and injury to the whole people. Nor can the most selfish of men drug himself with the comforting thought that only his descendants will feel these injuries. They are being felt today by every man in America.

In the first place the average price at the mill of all lumber in the United States has risen fifty per cent in the last eight years; the thousand feet of planking you paid ten dollars for in 1900 now costs you fifteen dollars or more. That means an increase in the cost of all building operations—stores and offices and homes cost more to build; rents must, therefore, go up and the primary cost of family life is increased.

Immense quantities of timber are used in all mines. A fifty per cent increase in the cost of timber makes coal, iron, copper—all kinds—of mining vastly more expensive. Add a quarter a ton more to coal to cover this rise, a fraction of a cent more to each pound of iron, and every householder in the land begins to feel the pinch—as, indeed, he has already felt it.

Lumber is needed in the manufacture of farm implements and utensils, it is used for fencing and in a hundred other ways about every farm. Now the farmer must pay fifty per cent more for it and he must add this increase to the cost of producing his wheat and corn and livestock. Therefore you and I and our next door neighbor pay more, in one way and another, for our bread and meat and other provisions.

With all these facts before us we grunt and grumble, and —— send Uncle Joe Cannon back to Congress.

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From the very beginning American forests have not been lumbered, but looted. Only a man who has actually visited the big woods after they have passed through the hands of the lumber companies can begin to realize the wanton ruin and awful desolation they leave behind them. A car load of anarchists, hurling dynamite bombs to right and left as they rush through the streets of Chicago could work no more utter wreck. San Francisco after it had been shaken by the earthquake and desolated by fire is the closest urban parallel. There are thousands of acres in northern Wisconsin and in every other great lumbering state, covered forty years ago with magnificent forests of white pine, which today are mere tracts of sandy wilderness, cut into deep gullies, covered with worthless scrub and thick dotted with the gaunt black trunks of burned trees. A man may drive for fifty miles through one of these burned-over districts and need no imagination to feel himself continuously in the close-lying suburbs of Hell.

Every year in the United States more than fifty million acres of forest are burned—more than the total area of the state of New York, with half of New England thrown in for good measure. Every year we destroy by forest fires enough timber to fill all the needs of the country for three months. And that with our present lumber supply almost certain to be exhausted in less than fifty years.

Already in many states some small precautions against forest fires have been taken. Strict laws have been passed to punish people who leave fires burning in the woods and a pitifully few forest rangers have been appointed. Yet the chief offenders remain untouched—the

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lumber companies, which pile high the ravaged woods with branches cut from their logs and leave them to dry until they are as quick as tinder to catch the slightest spark. It will do small good to punish a few careless hunters, to send out a few rangers to watch the woods, until every lumberman is compelled by severe penalties to clean up and make things safe after his operations. As well put an open can of gasoline in every room of your house and then go about warning people to be careful where they throw lighted matches! The needed laws must be passed by the legislatures of the several states and they will be passed as soon—and not before—as a united public sentiment demands their passage. Until that time the lumber barons, with "Get Rich Quick" emblazoned on their banners, will continue to insist on being allowed "to conduct their own business in their own way, without impertinent interference on the part of corrupt politicians and sensational journalists."

As was recently pointed out at the last Conference of the Governors at Washington it is possible to practically stamp out forest fires in this country at an annual cost of less than one-fifth of the actual value of the standing timber destroyed each year by forest fires. To the average citizen who is sustained by a soothing belief in his own sanity a proposition which insures an annual saving of $40,000,000 at an expense of one-fourth that amount sounds almost too good to be true. He is certain that it will be immediately adopted and put into practice. But he fails to get the point of view of the lumber companies. Suppose, for instance, that the Jones company owns the lumber on a thousand acres in one corner of the big woods of Minnesota. The land

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which surrounds it is owned by the Brown company. In the fall the Jones people put two or three camps of lumberjacks into the woods to get out their logs. By hard work they have stripped their thousand acres of big trees when the high water makes it possible to float the booms down river to the mills in the spring. Their land is left piled high with tangled mass of branches and other refuse. Why should they spend time and money to clean up and make the tract safe from fire? If fire comes there is none of their own property left to be damaged by the flames. The Brown company, whose still standing forest surrounds the cut-over tract, must look after its own. Not until strict laws are passed and as strictly enforced by the several lumbering states will there be any marked improvement.

The wise men of the Forest Service have taken a census of the timber still standing in the United States. This census is based on thousands of reports from as many county officers and on personal inspection by the foresters of the larger tracts of standing timber. They report that at the most there are 2,000 billion board feet of lumber still in the trees. The annual growth, at the highest, is not more than forty billion feet. The present annual consumption of lumber in the United States is one hundred billion feet. That leaves

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sixty billion feet which are taken from the forests each year in excess of the amount restored by growth. Anybody with a stubby lead pencil and a slight knowledge of plain division can arrive at the conclusion that, if present conditions continue, the timber supply of the United States will be entirely exhausted when children born this year are thirty-three years old.

But conditions will not remain the same. In the first place we use more lumber every year. In spite of the fact that since 1900 reinforced concrete has come into general use as a building material, in spite of the fact that 1907 was a panic year, more lumber was cut at the mills during 1907 than during any previous year. Since 1850, when the forests were practically virgin and the population of the country small, the average annual consumption of lumber per capita has more than doubled. And, unless something is done to prevent, the amount consumed will go on increasing and the price rapidly rising until in much less than thirty-three years the supply will be entirely exhausted and the lumber business—now ranking fourth in the value of its product—will necessarily become extinct.

What that would mean in increase in the cost of living, in suffering and in hopeless poverty, not the most saffron of alarmists can even imagine.

Few industries are so deliberately and intentionally wasteful as the lumber industry. None can be so except those which, in one way or another, have gained the legal right to loot the unguarded natural resources of the country and which are in a hurry to get rich before the people wake up.

Out of every thousand feet of lumber

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which stands in the forests at least one-quarter is left behind as kindling for forest fires or is otherwise lost in logging; the loss in the mills is from one to two-thirds of the lumber sawed; the loss in lumber, after sawing, in seasoning and otherwise fitting for use, is from one-seventh to one-fourth. So, under the present criminally careless methods, not more than 320 feet out of every thousand ever is put to a useful purpose—more than two-thirds of the forest crop is

wantonly and willfully wasted in order that the lumber companies may make the most money in the quickest time!

Thousands of acres of standing timber are killed and made useless in other ways. In the South, where the long leaf-pine is tapped for turpentine, one-fifth of all the forests worked have been killed and ruined by careless and reckless handling. In Wisconsin and other Northern states one may row for miles between

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HILLSIDES COVERED WITH TIMBER ARE PROTECTED FROM RAIN WASH.

DEFORESTED SLOPE OF AVALANCHE PEAK, GILA RIVER NATIONAL FOREST, NEW MEXICO.

These erosion gullies are from ten to twenty feet wide, and six to fifteen feet deep. They have appeared in the past four years.

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solid walls of dead trees killed by the back-water from the dams built by lumber companies to insure a sufficient head of water to run out their logs.

How to stop all this waste is a difficult problem. Has not the owner of timber land the sacred right to do as he pleases with his own? But it is a problem which must be solved if the threatening catastrophe is to be averted.

If the facts already presented are not sufficient to rouse the people to the necessity of interfering with the unrestrained private ownership and handling of the forests, there is another view of the situation which is even more serious and impressive.

If—as is sure to happen, unless decisive action is taken—the forests are wiped out of existence within the next fifty years, what will be the certain results? Floods, which now do damage yearly to the extent of a hundred million dollars, will be more common and more disastrous in the proportion of two or three to one; whole square miles of what is now fertile farming land will be cut up into ditches and ridges and rendered absolutely useless; irrigated farming will vanish utterly and the splendid project of a great system of inland waterways, navigable all the year round, will become forever impossible.

As long ago as 1896 Professor Shaler of Harvard, than whom no man has spoken with greater authority on the subject, estimated that in the upland regions of the states south of Pennsylvania, alone, three thousand square miles of fertile soil had been absolutely washed away and destroyed by floods as the result of the uncontrolled cutting of the forests and that the same waste was still in progress

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at the rate of more than one hundred square miles of soil each year.

The tremendous effect of standing timber in holding back floods and thus preventing disastrous soil erosion has been strikingly illustrated by careful experiments made by the Forest Service. Two tracts of land, similarly located in the San Bernardino country of California were selected. From one the trees had been cut off; the other was still covered with standing timber.

Careful observation and actual measurement showed that from the bare tract, after thirteen inches of rainfall, nearly fifty per cent of the water ran off at once into the brooks. From the forest tract, after nineteen inches of rain had fallen, only six per cent of the water ran off immediately into the streams, the rest soaking into the ground.

At the end of the second month after the rain ceased the bare tract of land was absolutely dry; the beds of the brooks empty; the whole surface covered with dust which blew about in the wind. On the forest tract, on the other hand, there was still plenty of moisture and the brooks which drained it still carried a fair supply of water, which gradually seeped out from about the roots of the great trees.

In addition to everything else, therefore, the reckless destruction of the forests means droughts and crop famines, dry rivers and raging floods, fat farm lands swept off into the sea and irrigated valleys turned back again into bare deserts. Lumbering is one of the half dozen great fundamental industries—all concerned with the development and use of the great God-given natural resources of the country—upon which all national prosperity, all well-being and happiness

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for the great mass of the people absolutely depend. And if it—and the others—are not soon controlled and managed in the public interest the great mass of the people may as well realize that their opportunity in America is gone by forever.

It is a pleasure to turn from this black picture, which hangs just inside the cur-

tain of the future to look at what is being done here and now to make the forests what they should be—a permanent source of supply, a perpetual safeguard and resource for all the people. And surely before long a people which is, after all, the most grateful—because the most intelligent—in the world will insist on erecting, alongside of the statues to Washington, Lincoln and Grant, a monu-

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ment to Gifford Pinchot, Chief Forester of the National Government since 1898. Before him forestry was unknown in America. To his efforts is due the fact that at present one-quarter of all the standing timber in the country, covering an acreage three times the total area of the state of New York, is set apart in public forest reserves, where it is safe from the vandals' axe and year after year produces, in increasing abundance, its regular crop of marketable lumber. In doing this great work, Pinchot has done vastly more. He has set up a new ideal of unselfish public service before the rich young men of the United States. In the new Grand Army of Volunteers, which is beginning to do such magnificent work for the commonwealth and the common weal, Pinchot was the pioneer. Born to a large fortune he has used his thorough education, his great ability, his gracious tact, in the patient pursuit of a patriotic purpose. He—but Pinchot is young. He was born since the Civil war. Pinchot can wait. It is the forests which still need immediate attention.

The forests which are still standing cover five hundred and fifty million acres —about one-quarter the whole territory of the United States. Originally nearly one-half of the country was wooded. Of these standing forests one-quarter is publicly owned. This quarter contains only one-fifth of the total supply of standing timber. Private owners have gobbled not only three-quarters of the total area, but, at the same time, four-fifths of the total timber. Scientific forestry is practiced on seventy per cent of the public forests. As soon as the Congress can be persuaded to make the necessary appropriations it will be extended to the whole area. And even on the privately owned three-

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quarters a start has been made. As a result of Pinchot's efforts and of his example a yearly crop of lumber is now scientifically harvested on one per cent of the vast domain. Altogether nearly one-fifth of the total forest area—including both public and privately owned forests—has been put on a permanent and sane basis.

But that is only a beginning. The Congress, which, under the dictatorship of Cannon, has refused to pass the bill setting aside the Appalachian Forest Reserve, must be forced—at whatever cost to political fences around business pastures—to pass the bill and make ample appropriations for the proper protection and working of the reserve.

The several states must take up the work as, indeed, most of them have promised, through their Governors, to do. To Minnesota, for instance, the Federal Government has already given a great tract of primeval pine forest which lies about and encloses Lake Itasca and the other little lakes which are the ultimate sources of the Mississippi. There are fifteen thousand acres in this splendid park and it has been turned into a great School of Forestry for the young men of the state. Minnesota has also a department of Forestry of its own and has passed laws encouraging the planting of forest trees. What this means to the whole country may be gathered from the statement that before the Father of Waters can be turned into a great floodless river navigable all the year round—instead of a dangerous and destructive trunk line sewer—there must be at least three million acres of forests planted about its headwaters. When that is done and after the first trees have reached maturity, the annual harvest under scientific forestry

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is estimated at not less than seven hundred million board feet—one-tenth of the total production of pine lumber in the greatest year of its production.

With both the national and state governments at work the private owner must be controlled and taught the error of his ways.

Already a beginning has been made. Many large private estates—among which Biltmore, George Vanderbilt's great plantation in the Carolinas, was the first—are now managed by scientific foresters. Several railroads, all of which consume vast quantities of lumber in ties and telegraph poles, have started forestry plantations on a large scale. Notable among these is the great Pennsylvania company, which has established at Morrisville, Pa., a large forestry nursery, where millions of seedling trees have been set out, to be transplanted later on waste lands owned by the company in various parts of the country.

Most important and most significant of all is the announcement recently made by Edward Hines, of Chicago, himself one of the leading lumbermen of the country, and a partner with Frederick Weyerhaeuser in at least one company with enormous holdings, that in cutting the timber from the tracts which it controls every precaution will be taken to clean up the slashings, so that there will be practically no danger from forest fires.

Mr. Weyerhaeuser is credited with owning vastly more standing timber than any other man in the United States. He works through a large number of corporations, in each of which he is the controlling spirit. The total holdings of the Weyerhaeuser companies is said to be thirty million acres, an area almost equal

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in size to the State of Wisconsin. Almost all the great industrial corporations are large holders of standing timber, among them the United States Leather Company, which holds title to 500,000 acres of hemlock timber. Everywhere the tendency is to concentrate ownership into fewer hands.

Meanwhile Congress and the legislatures of the several states are far from doing their duty in the direction of stopping the present waste of timber and in providing for a future supply, which—unless immediate action is taken—will certainly be entirely exhausted within fifty years. Judging by the experience of European nations there are several directions in which legislation is needed.

In Germany, for instance, no man may cut down a tree without replacing it by planting two or three more. And, if the timber be growing on a slope which would, if deforested, precipitate a considerable body of water into a river—thus causing floods—the trees may not be cut at all, except such a small portion of them as each year reach maturity.

Most important of all, when it comes to recreating the devastated forests, the Germans do not tax growing forests for thirty years after the young trees are first planted. By that time, under proper conditions of scientific forestry, a permanent and regular annual crop may be cut and the forest may well bear its just share of the burden of taxation.

It would seem to be a fair and wise government which, if it somewhat curtails the immediate profit of the forest-owner—to the end that the people may not suffer—also takes from him a part of the burden when he undertakes the work of reforestation, from which all the people are to profit.

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SHORTCUTTING THE ATLANTIC SHORE LINE

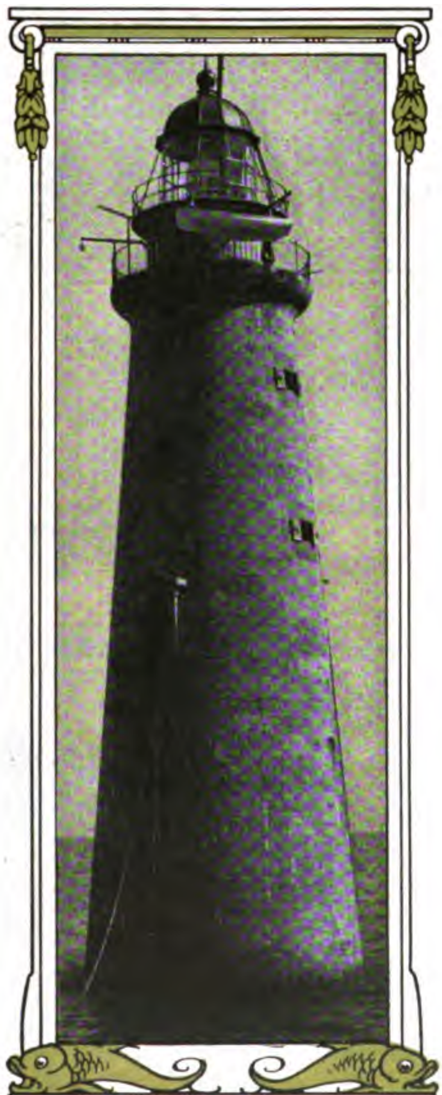
By WILLIAM ATHERTON Du PUY

THE coastwise trade of Delaware Bay and Chesapeake Bay combined amounts to more in tonnage than does the entire foreign trade of the nation. Yet all interchange between the two bays must take the long detour by way of the ocean when they could be connected by a canal fourteen miles long, and 318 miles in distance saved.

In 1907, 18,000,000 tons of freight went to Boston by water from the south, the amount being four times what would have gone through the Panama Canal during the same year had it been completed. All this shipping could have been saved 148 miles around Cape Cod and the dangers of that most hazardous coastline by the digging of a canal seven and one-half miles long across the Cape.

The Delaware and Raritan Canal, which virtually connects New York and Philadelphia, was being operated on a basis for getting the business in 1870, and in that year handled as much trade as did the Suez Canal, it aggregating 4,000,000 tons of freight. Yet soon after it was bought by a railroad company and suppressed; expensive freight rates by rail followed, with the alternative of an unnecessary 184 miles by way of the ocean. The South is now producing more than a billion dollars' worth of raw material annually and consuming hundreds of millions of dollars' worth of manufactured products. Yet all of these pay high freight rates by rail or are forced to take the long and hazardous trip by water around Cape Hatteras. Yet the waterways back of Hatteras but need improving to obviate the danger and greatly shorten the distance.

In all 700 miles, nearly half the distance by the present route, could be clipped off the trip from Boston, Mass., to Beaufort, N. C., a placid inland waterway could be substituted for a dangerous open sea along a treacherous coast, the cheapest of traffic, that of tugs and barges, could be established for the whole of the Atlantic seaboard, and a safe harbor brought to every city and hamlet along the route by the simple building of the necessary links to complete the water



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MINOT LEDGE LIGHTHOUSE, BOSTON.
One of the beacons that the dangerous coast line renders necessary.

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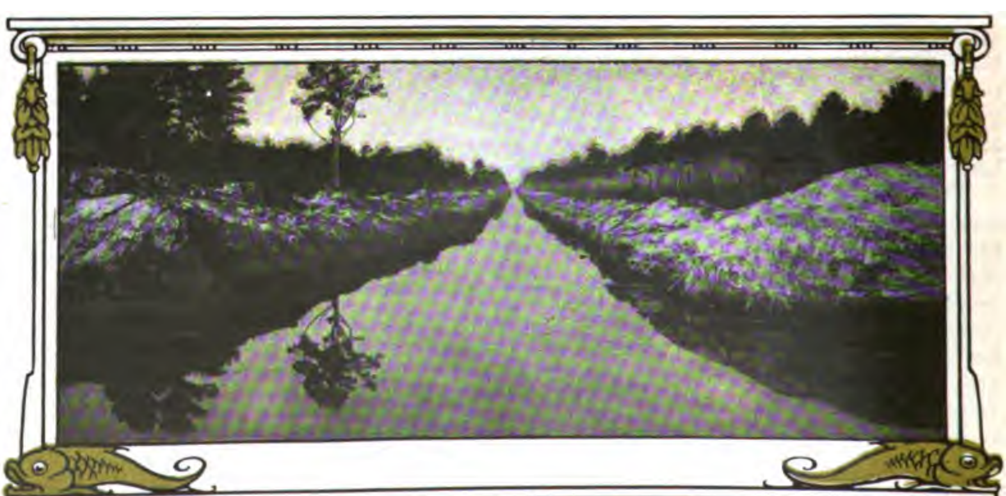
chain. To accomplish this there is the proposition for an inland coastal canal for the Atlantic seaboard which, though still somewhat in the formative state, is destined to be one of the great governmental movements of the near future.

The series of inlets along the coast form the greater part of the waterway proposed. The cutting of the channel through Cape Cod will allow a protected passage from Boston Bay into Long Island Sound and through New York Bay to the New Jersey Shore. The cut across that state of thirty-one miles supplies the link to the Delaware River above Philadelphia, while fourteen miles of canal will connect Delaware Bay and Chesapeake Bay. Back of Hatteras the problem is simple. In none of these links are there engineering difficulties of any great magnitude to overcome. There is merely the problem of excavation to be made and the necessary money with which to make it. There is not even the task of blasting a way through rock ledges, for there is practically no rock encountered in any of the projects. All that is needed is the wherewithal to make the dirt fly and an attractive, alluvial soil is supplied for the flying. Not even a tide lock is deemed necessary in all the plans, and when the scheme is worked out there will be smooth sailing over an unobstructed course throughout the entire distance, with no obstacles and no fees to pay for the privilege.

J. HAMPTON MOORE, CONGRESSMAN FROM PHILADELPHIA AND PRESIDENT OF THE ATLANTIC DEEPER WATERWAYS ASSOCIATION.



AN ABANDONED CANAL CUTTING IN THE DISMAL SWAMP.
A stretch of marsh typical of the coast regions of Virginia and the Carolinas.

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Thirty million people live tributary to this region which does the mass of the trade of the nation, and all of these would feel the effect of water traffic rates which have been demonstrated to be sixty-six per cent cheaper on the average than transportation by rail, and under most favorable conditions to amount to less than one-sixth of that cost. Coal would be cheaper in every household in New England. Manufacturers in the North would receive cotton burdened with a much lighter freight charge and the cities would get Southern produce cheaper. The South would receive its manufactured materials at a lower price and find markets opened to produce that could not be reached on the old basis. The country tributary reaching far into the interior would pour its production down into this trough of trade for distribution and reap the benefits it would offer.

This inviting prospect of 800 miles of placid, protected waters skirted by green fields and prosperous manufacturing cities taking the place of twice that distance of storm-swept ocean, rimmed by lurking sand banks and jagged, rock-toothed cliffs, would mean things untold to the trade of the nation. It would mean the supplanting of danger for safety, extravagance for economy, and seaport privileges to an entire seacoast.

Then the main waterway would become a nucleus for a system of canal transportation that might be developed indefinitely, for the conditions are inviting for the extension southward to Florida and ultimately to the Mississippi and the Rio Grande. The Schuylkill Canal runs into the coal producing sections of Pennsylvania and once was employed in bringing coal to tide water, and performed the service profitably at forty cents a ton. It was bought by the Reading Railroad and has fallen into disuse and the present rate for the same haul is $1.40 a ton. The Chesapeake and Ohio Canal has suffered a similar fate, as has the Lehigh and others.

These might be taken over by the government and made part of the enlarged system. Albert Galletin, Secretary of the Treasury for Thomas Jefferson a hundred years ago, and one of the men who has left his imprint upon the nation's developing map, planned the connection of the Tennessee River with the Atlantic Ocean and also sought to reach the headwaters of the Ohio with a canal from the seaboard.

Traffic on the Present Chesapeake and Delaware Canal.
This canal will form part of the waterway from Massachusetts to Florida.

In the face of which facts the business interests of the Atlantic Coast are lining up under the leadership of the Atlantic Deeper Waterways Association and propose continuing an organized business campaign for a coastwise water route until their requests are granted by Congress. They are asking and will continue to ask that the canal be cut through Cape Cod, that the Delaware and Raritan Canal be taken over by the government, improved and enlarged, that the canal

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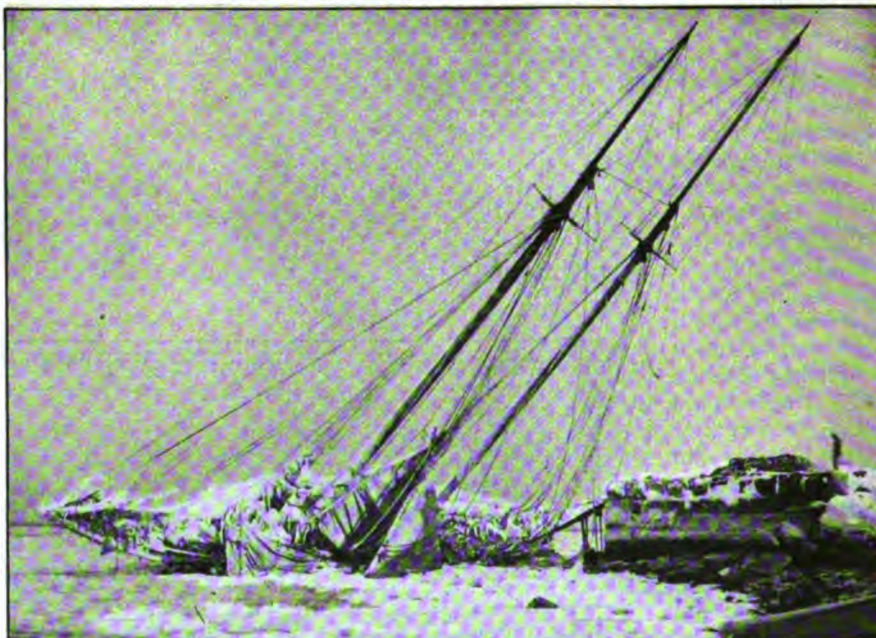

A PICTURESQUE OLD WRECK ON THE MASSACHUSETTS COAST.

T-WHARF, BOSTON—THE GREATEST FISH MARKET IN AMERICA.

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connecting the Delaware and the Chesapeake Bay be taken over and adapted to the trade, and that the waterway bank of Hatteras be completed.

Congressman J. Hampton Moore of Philadelphia stands sponsor for the Atlantic Seaboard deep waterways, and is the active spirit and official head of the Association. Still back of it is the great movement in favor of Inland Waterways in general which, during the past year, has grown into a recognized policy of the nation to be worked out during the next decade and the next. It is the nonpartisan policy in which the governors of all the states have met in agreement with President Roosevelt and in which the leaders of both parties have declared themselves in perfect accord.

As the policy of Inland Waterways on a large scale takes shape the great undertakings that on the face of it appear most imperatively necessary are the establishment of the Mississippi navigable channel from the Great Lakes to the Gulf and the Coastal Canal along the Atlantic seaboard. These are not rival but companion movements, the one as important as the other and both parts of the great scheme of providing ample transportation, for a lack of which progress is being retarded.

The proposed cut which would link Massachusetts Bay with Long Island Sound would save 170 miles in the trip between Boston and New York or other points south for those vessels which customarily skirt entirely outside of the dangers of Nantucket Shoals. For those vessels that run the risk of going inside among dangerous reefs and taking the shortest possible route there would still be a saving of seventy miles. These savings for each vessel that makes the trip into Boston from the south in one year would amount to sufficient mileage to wrap many times around the world in criss crosses from all points of the compass.

Aside from the saving in miles and time, there is the consideration of the vessels that batter themselves to pieces off Cape Cod every year and the toll in human life that these dangerous rocks annually reap. Within the last twenty years a thousand wrecks have taken

A ROUGH STRETCH ALONG THE MASSACHUSETTS COAST.

their places along this stretch of coast as monuments to its treachery, and unnumbered lives have been offered up with them. It is a veritable graveyard of craft. Statistics show that a stretch of thirty miles along Cape Cod is responsible for one-fourth of the disasters of the whole New England coast.

Added still to these losses is the direct cost of insurance which is assessed against every cargo that rounds Cape Cod and runs its well recognized dangers. This sum in itself is estimated as sufficient to build and maintain the canal. The very material delays that are constantly occasioned by bad weather would also be obviated.

Such a canal across the cape has been planned since the very early days of the colonies. In 1676 Samuel Sewell wrote

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THE WATERFRONT, AT NORFOLK, VA.

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A GENERAL VIEW OF THE SHIPYARD AT NEWPORT NEWS, VA.

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SUNSET AT ST. AUGUSTINE, FLA.

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SHIPPING IN THE FORE RIVER, MASSACHUSETTS.

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A GENERAL VIEW OF THE WATER FRONT AT BOSTON.

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that, "Mr. Smith, of Sandwich, rode with me and showed me the place which some had sought to cut, for to make a passage from the south sea to the north." As a, local, state and national issue the project has been recurring ever since until just now private enterprise is threatening to build the canal and, of necessity, assess the boats going through it for the cost.

MAP SHOWING THE PROPOSED CANAL ALONG THE ATLANTIC COAST, WHICH WILL LINK MASSACHUSETTS BAY WITH THE FLORIDA KEYS.

The task of digging it has no special difficulties. The cut would be entirely through a sand and gravel formation and would be expensive in proportion to the size and depth decided upon. There would be a very great difference between the cost of a canal sixteen feet, twenty-eight feet or thirty-five feet deep, but for even the largest the cost would not be prohibitive.

The Delaware and Raritan Canal when developed in proportion to the national idea of such a waterway, would be thirty-one miles in length, connecting the waters of New York Harbor through the Raritan Bay at New Brunswick with the Delaware River at Bordentown. If it were twenty-eight feet in depth it would cost something like $25,000,000. It would reduce the distance between New York and Philadelphia from 247 miles to ninety miles, or nearly seventy per cent. and at the same time complete one of the most important parts of the proposed continuous waterway.

This canal actually demonstrated itself by developing a trade of 57,000 tons in 1835, shortly after it was completed, to 4,000,000 in the year 1870, when it reached the height of its usefulness. In that year the Pennsylvania Railroad leased it for a term of 999 years and its trade has since been suppressed and it is now used scarcely at all.

The original canal was built in three years despite the crudeness of the machinery of those early days. There are no difficulties to be met and merely the problem of accomplishing the given amount of excavation is to be solved. The old canal can accommodate craft drawing no more than six feet of water and would be of no great value to the government, and its route might not be followed in the plans eventually decided upon, for there are other available routes.

This canal would bear most directly upon the domestic commerce of New York and Philadelphia. In this connection it is interesting to correct the error in the commonly accepted belief that the most important trade of New York City is its foreign trade. On the contrary, the domestic waterborne traffic of that harbor is more than five times

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TERMINAL PIERS OF ONE OF THE COAST NAVIGATION COMPANIES, AT NEWPORT NEWS, VA.

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A FLEET OF FISHING SCHOONERS AT THE T-WHARF, BOSTON.

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THE OLD AND THE NEW LIGHTHOUSES AT CAPE HENRY.

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A SCENE ALONG CANAL THROUGH THE DISMAL SWAMP, VIRGINIA.

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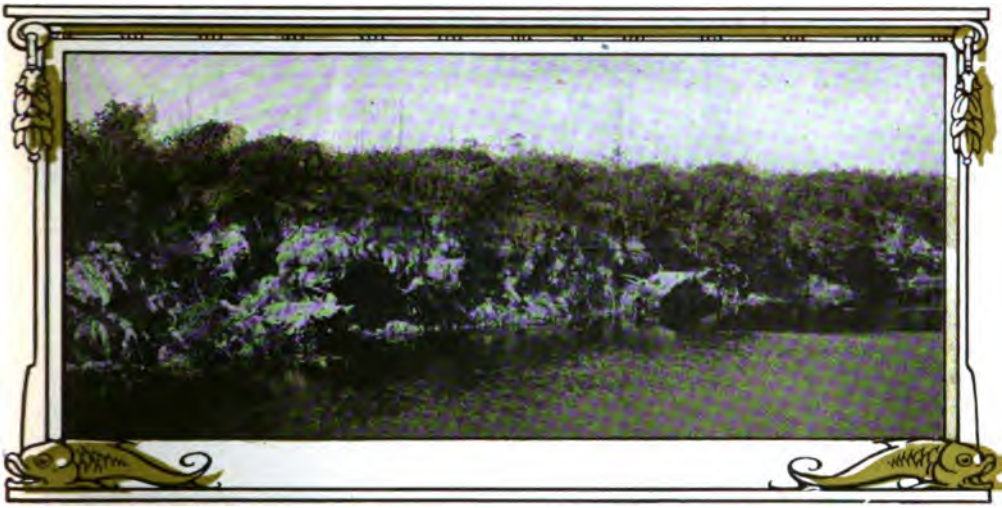

THIS KIND OF SOIL—A SANDY LOAM—IS THE DELIGHT OF THE CANAL BUILDER.

as great in bulk as is its foreign trade. The value of the foreign trade in 1907 was $1,500,000,000, while the domestic trade amounted to $8,000,000,000.

The third link in the chain, the Chesapeake and Delaware Canal, as at present existing, is similar to that in New Jersey, though larger and better maintained. It has fallen largely into disuse and is now capable of handling practically none of the trade that it would accommodate under the right conditions. It is fourteen miles long and if developed would save a distance 318 miles between Baltimore and Philadelphia.

In Florida the Canals Pass Through Regions Where Vegetation Runs Riot.

At present it has a depth of ten feet. Government engineers have examined the present canal and calculated the expense of its purchase and development into a magnificent waterway with thirty feet depth and place the figure at $17,000,000. This link in the inland waterway is also without any material difficulties to be met and could be readily and quickly completed.

This connection between the Delaware and Chesapeake bays is considered the most important one in the whole chain. These two bodies of water have a shore line of 2,500 miles with 500 tributary streams and 10,000 registered vessels. The estimated tonnage of the shipping of the two is placed at 70,000,000. In the states bordering on the two bays there is a population of 12,000,000 people. The great coal producing sections of the world are immediately tributary to them and the ability of the section to handle economically the great masses of freight brought down affects the well being of half the people of the

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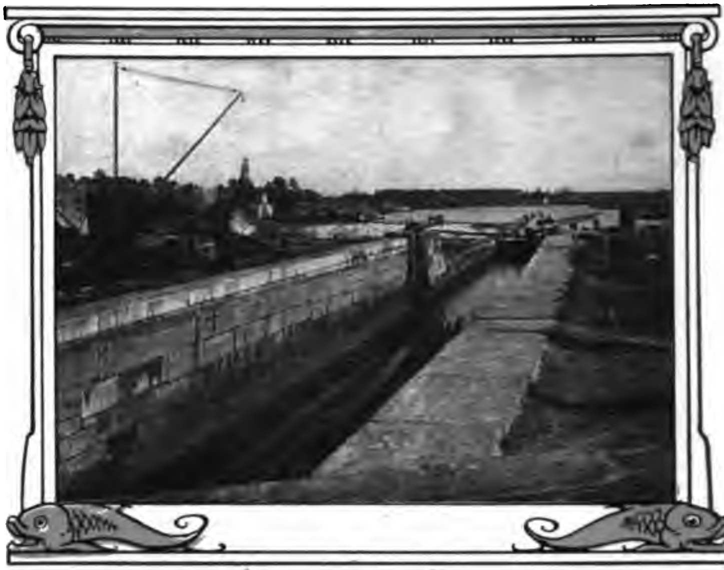
United States and coal consumers in many parts of the world.

Finally comes the last link that connects all the other with the great, productive South, the Norfolk-Beaufort route behind Cape Hatteras. Already the national government has appropriated funds and is even now digging such a canal for the accommodation of small craft only. This may be easily enlarged when the necessity arises for the accommodation of the largest ships afloat. From Beaufort Inlet in North Carolina a land cut is to be made which will utilize Core Creek and Pamlico Sound, thence through Croatan Sound and Albemarle Sound and other smaller bodies of water until the Elizabeth River is reached and, through it, Norfolk harbor.



A CANAL LOCK ON THE ALBEMARLE AND CHESAPEAKE CANAL WHICH WILL BE ABANDONED AS TOO NARROW FOR PROPOSED HEAVIER TRAFFIC.

The formation here and on to the southward is peculiar. Along the coast a series of sandy islands have been thrown up by the action of the waves and back of this is a string of protected inlets. These range all the way to Florida and through them is planned the ultimate extension of the scheme.

A LOCK IN THE CHESAPEAKE AND DELAWARE CANAL.

Each link in the chain is regarded as a desirable and advisable undertaking with a view to its local significance only, but the waterway is of importance on the large scale, when considered from the standpoint of continuous waterway that will not merely accommodate existing trade but open up a new era of activity in interchange between the remote sections upon which it will draw. Safe going for tug boat and barge traffic means the cheapest hauling that is known to man and this would be the ideal conditions for the navigation of the canal.

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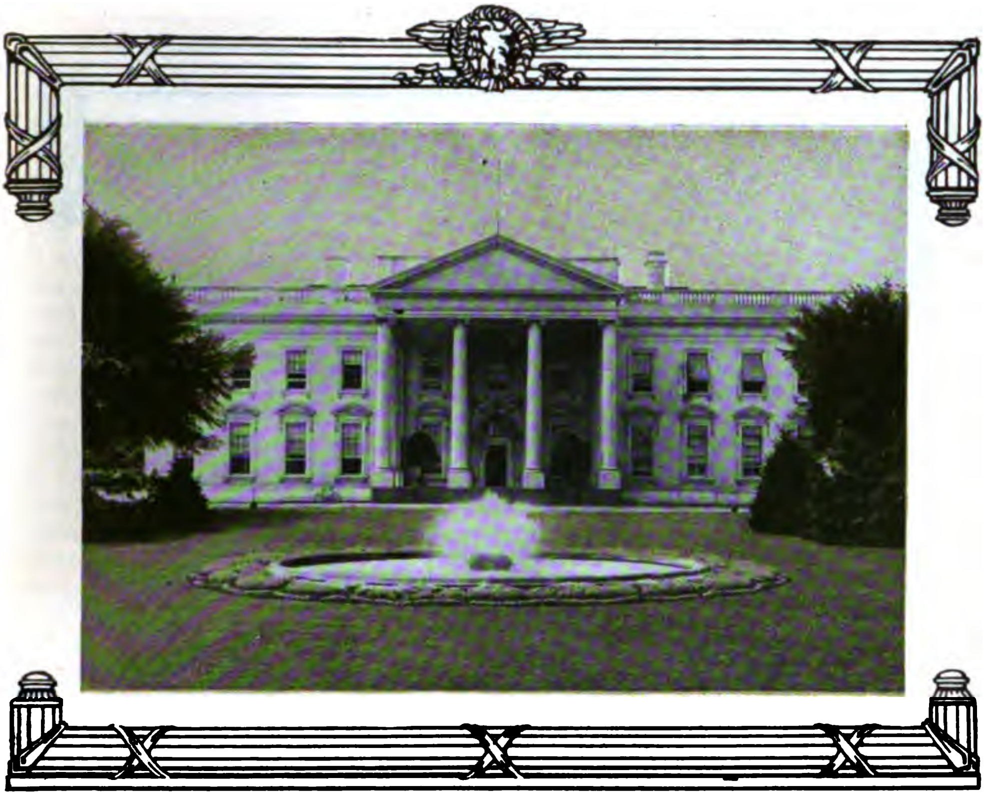

FRONT OF THE WHITE HOUSE. NOW THE PRESIDENT'S PRIVATE ENTRANCE.

NEW HOME OF MR. TAFT

By NEWTON FOREST

WHEN William Howard Taft steps into the White House at noon on the fourth of March as the new President of the United States of America, he will find a model home equipped with every modern convenience; that is what other Presidents have never enjoyed. Before the election of President Roosevelt few changes had been made in the White House since the days of John Quincy Adams, when it was rebuilt after being fired by the marauding British troops, only the walls being left standing.

The Executive Mansion, as it was called before the advent of Mr. Roosevelt—he dubbed it officially "The White House"—was the first public building erected at the seat of government. The architect was James Hoban, who drew his plans closely after those of the seat of the dukes of Leinster, near Dublin, Ireland. George Washington, himself, selected the site, laid the corner stone on October 13, 1792, and lived to see the building completed. John Adams, however, was the first President to occupy it, which he did in 1800.

When Mr. Roosevelt entered the White House he found that Uncle Sam had supplied him with nothing more than

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THE BLUE ROOM. WHERE PRESIDENT TAFT WILL STAND AND SHAKE HANDS WITH THOSE WHO CALL ON PUBLIC RECEPTION DAYS.

an antiquated flat over what might be termed part of a national museum, and this flat was crowded around by public offices. State dinners were being held in a draughty upstairs hallway; reception guests were making their entrance from a front window, and the President himself couldn't take a bath in his own cramped quarters without being disturbed by some intruder. This state of affairs put the President up in arms, and he told the leaders in both houses of Congress in a straightforward way that a president of a respectable nation should be provided with a better home. It was only a short time after this interview that the money—and plenty of it—was appropriated for the new White House. An office building was promptly erected for the President and his host of clerks which is connected with the main building by an esplanade, and the old Executive Mansion was again restored to its dignified grandeur. All of the broken and much abused furnishings were sold at auction and new and simple sanitary furniture put in. The whole of the interior of the building was then redecorated in classic good taste, and the White House today is the most stately type of colonial mansion in America.

Besides those already referred to many other alterations and changes were made. The public entrance—now the President's private entrance—was formerly on the north front, now it is through a colonnade on the east. This leads to the basement corridor, on the walls of which

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THE PRESIDENT'S NEW OFFICE AND THE "PRESIDENTIAL CHAIR."
The new cabinet room adjoins through the folding doors.

are hung the portraits of the mistresses of the White House, including those of Angelica Singleton Van Buren, who was mistress of the Mansion during President Van Buren's term; Mrs. Tyler, Mrs. Polk, Mrs. Hayes, Mrs. Harrison and Mrs. Roosevelt. The portrait of Mrs. Hayes was presented by the Woman's National Temperance Union, in recognition of the cold water regime of the White House during President Hayes' term. From the corridor broad stairs lead up to the main corridor, from which access is had to the East Room, and the Blue, Green and Red rooms, which take name from the predominating color of the decorations and furnishings. The East Room, or official state parlor, used for receptions, is a magnificent apartment forty feet wide by eighty-two feet in length, and with a ceiling twenty-two feet high, from which hang three massive crystal chandeliers. The decorations of walls and ceilings are in white and gold, with mouldings and tablet ornamentation in relief, and window draperies in old gold.

The Blue Room, oval in shape, is the President's reception room. In this room Mr. Taft will stand and shake hands with all who may wish to go whenever there is a public reception. The walls of this room are covered with rich blue corded silk, and the window hangings are blue with gold stars in the upper folds. On the mantel is the clock of gold presented by Napoleon I to Lafayette and by him to Washington; on either side stand the bronze vases presented to Washington at the same time.

The new state dining room of the White House makes glad the eye of the one who is fortunate enough to

WHERE PRESIDENT TAFT WILL PLAY TENNIS.

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be an invited guest to a banquet there. This handsome room is paneled in dark English oak and decorated with heads of American big game. To this collection of trophies have been added several fine specimens killed by President Roosevelt. The white marble mantel is surmounted by an old Flemish tapestry depicting a country scene and having in a panel a verse from Virgil in praise of hunting. The massive mahogany table will seat one hundred guests.

The Red Room.
The portrait of Washington, over the mantel, was taken from its frame and carried to safety by Dolly Madison when the British pillaged the White House in 1814.

President Taft's comfort, however, will not be the only thing that is to be well looked after, for during Mr. Roosevelt's term of office the Congress has made excellent provisions for the better protection of the life of our President. The law now provides a death penalty for an attempt upon his life, while a mere threat to kill him, or even the advising of another to do so, is punishable by imprisonment for a long term of years. In the new Union Depot at Washington there is provided a handsome private waiting room which Mr. Taft will use whenever leaving the capital, so that he will not come in contact with the masses of the traveling public. This will prevent the repetition of the Garfield tragedy. To guard against another McKinley tragedy the secret service force assigned to protect the President has been considerably increased, and these men are the only ones in the service who can safely disregard the President's order. Mr. Roosevelt never liked to have these men around and tried in many ways to evade them, but they are always on the job. Whoever is President must forever be dogged by these hawk-eyed men, for that is their sole business. They even guard the President's chamber while he sleeps.

President Taft will have many advantages and pleasures which former occupants of the White House never dreamed of. When he travels all of his expenses will be paid by the government, for which purpose just $2,083 a month is laid aside in Uncle Sam's money box. If he wishes to take a sea trip he has the choice of two private yachts at his command — the *Mayflower* and the *Sylph.* The *Mayflower* is a boat of 2,700 tons, and was built especially for Mrs. Ogden Goelet, who originally paid $800,000 for it. During the Spanish War the government purchased it for $450,000. It has recently been luxuriously furnished to meet the demands of the President and his family. While Mrs. Roosevelt occasion-

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THE STATE DINING ROOM. THIS TABLE MAY BE EXTENDED TO ACCOMMODATE ONE HUNDRED GUESTS.

ally uses this craft for pleasure trips, President Roosevelt says there is not room enough on it for him, and he has only made use of it when he was obliged to do so officially. When he visited Panama he took a battleship. If the *Mayflower* is too small to hold Mr. Roosevelt it is a cocksure thing that it will not hold Mr. Taft.

When Mr. Taft becomes President should it be his misfortune to become sick he will have no doctor bills to pay, for being the commander-in-chief of the army and navy, he may call in the services of army surgeons, part of whose duty it is to give medical attention to officers and their families. Moreover, should he, by ill fate, die in office, all of his funeral expenses would be defrayed by the government, and his widow would be given a life pension of $5,000 a year and the free use of the mails.

In order that Mr. Taft may not be annoyed by petty details, he will have an office force receiving $62,000 a year, headed by a private secretary who will receive $7,500 a year in addition. A contingent fund of $20,000 will be allowed him for stationery, reference books and the like. He will not be bothered with any great amount of official mail, for his three secretaries will attend to all matters of minor importance, and there will be but a small percentage of his correspondence to which he will have to dictate replies. Not like in days of old, it will be a rare occasion when he sits down to pen a letter—his duty will be to merely sign his name to a small percentage of the letters that are written in the

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THE RE-DECORATED EAST ROOM.

White House office—a percentage that is indeed very small.

The government pays for all the servants of the White House, even to the man who shaves the President. But Mr. Taft will have to pay his coachman out of his own pocket, as well as provide his own horses for driving and riding purposes. President Roosevelt has always preferred a carriage to an automobile, although at Oyster Bay last summer he was induced to use a motor car and liked it pretty well. However, he has never used one in Washington. Whether Mr. Taft will take kindly to the automobile as an official vehicle cannot be guessed at this time, but the time is sure to come when a motor car will be a part of the equipment of the White House.

Mrs. Taft has the reputation of being an excellent housekeeper, but little of this kind of work will fall to her lot as mistress of the White House. A steward is provided at $1,800 a year to look after such matters. It is his duty to hire all the servants, give orders to the housekeeper and do all of the marketing. This important functionary is provided with a government dayton wagon to do his shopping. He is a sworn government official, who under the terms of a bond of $20,000, given before he enters upon his duties, is personally responsible for all government property used in the White House. This includes table linen, plate, glass, furniture, carpets and ornaments. Whenever the first lady of the land wishes any repairs or changes made she has simply to call upon the engineer officer of the army, who is detailed in the dual capacity of superintendent of public buildings and grounds and master of

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ceremonies at the White House. He is allowed $35,000 a year for the care of and refurnishing of the mansion and an equal amount for repairs, $6,000 for fuel, $9,000 for greenhouses, and $4,000 for taking care of the White House grounds. All food bills, including those for which the President must contract for the four state dinners given each year, or for the entertainment of distinguished foreigners in Washington, must be paid out of his own private funds. The four state banquets usually cost about $1,000 each. The floral decorations for the White House, however, come from the government greenhouses. The music, too, is free, being furnished by the famous Marine Band at Washington.

In the basement of the White House the new mistress will find two modern kitchens, a large laundry room and a wonderful pantry containing an electric dish-heater with a capacity of 3,000 dishes and plates. At the state dinners, over which she presides, the viands, prepared in her two kitchens by one of the best caterers in the country, will be served on a $30,000 service of Wedgwood china, besides the new glassware bought under the Roosevelt regime, and the historic silver plate which has been collected by White House matrons since Adams' time. On formal occasions the guests will be presented to Mrs. Taft by uniformed army and naval officers detailed as social aides to the President.

NOTHING WRONG AT PANAMA

By ROY CRANDALL

DID a portion of the Gatun Dam slip and sink? If so, why?

Some say it did—some in fact, say that the Utopian plan of the engineers who were hurled into the task of constructing the Isthmian Canal by an eager President, is to float the vast structure of sand and clay on an oozing sea of mud, and that some fine day the entire mountain now being erected will sink out of sight and let the unleashed Chagres Lake there to be formed, carry destruction to the balance of the big work.

To which pessimistic prediction—when I voiced it to an official of the Construction Department of the Canal a few days since, came back the reply: "Veriest tommyrot, sir; veriest tommyrot, and with no grounds for its repetition. The foundation under the dam site is clay, conglomerate and sandstone. Borings have revealed it and test pits have proved it."

To supplement the statements letters and reports were produced, all tending to show that though the earth may slip and slide on the Isthmus, and though pessimists may claim that the present route was conceived in chicane and born in graft the Commission is calmly of the belief that the work has been planned in wisdom and is being progressed with safety and certainty.

Today one editorial cavalcade with civil engineers in attendance is nearing the Isthmus bent on learning the true nature of the foundation on which the dam is to rest or not to float, and a Congressional junketing delegation, called by courtesy an investigating delegation, is also en route for the Canal zone. President-elect Taft has also determined that they must "Missouri him" before he moves his trundle bed into the White House and places his slippers before the grate where Theodore's slippers now toast.

If the Ruler-to-be; the wielder of the Archimedian lever and his entourage, and the Congressional Canal critics are to ask questions when they arrive at the headquarters of the Chief Engineer here is what they will be told:

One—That while the engineers were

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TENTH STREET, COLON, BEFORE PAVING

embarrassed by frequent land slides the results have had no effect on final results and that steps have been promptly taken to guard against damage from this class of unlooked for contingencies.

Two—That ground water has been found under the site of the dam in the conglomerate and through the stratum of soft sandstone; the source of supply apparently being ground water from the hills to the Southeast and at a considerably higher elevation.

Three—That there is no question that the various materials will bear the greatest loads that can be transmitted to them by the lock walls if provision is made to prevent the underground flow of water through the softer materials on which part of the wall will rest.

Four—That it is practicable to prevent the access to the foundation of this water by means of curtain walls connected with an underlying stratum of argillaceous sandstone and that that will be done, while additional precautions will be taken during actual construction if developments make them necessary or advisable.

Five—That during the past year borings previously made to determine the character of the foundations were continued and the depths of the strata were determined definitely, and proof was adduced that after a stratum of argillaceous sandstone, a layer of conglomerate of pebbles and other hard aggregates requiring blasting to remove it were found; that in turn, being underlaid by soft sandstone and some volcanic tufa and then again by a dense argillaceous sandstone of considerable thickness.

Six—That the foundation for the Gatun Dam is capable of safely bearing any load the engineers feel inclined to create at that point and that the plans, as prepared, will be carried out as rapidly as conditions will permit.

There in tabloid form is the state of affairs as the officials of the Commission claim to view them and as they wish the world to see them. That many will refuse to look at the question through the rosy-tinted glasses the officials are willing to provide for doubting spectators is certain, because the muck-raking operations of certain big newspapers have stirred a sensation and have caused many to be-

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TENTH STREET, COLON, AFTER PAVING.
Compare with illustration opposite. An example of what the Americans are doing for the Republic of Panama

lieve that somewhere in the Isthmian Canal woodpile there lurks a monster of sinister mein.

They think so for three reasons. In the first instance many wonder why three famous and competent men like John F. Wallace, Theodore Shonts and John F. Stevens in turn took up the task of building the Canal and in turn laid down the burden and went to private life. To successfully carry forward so vast a task as bisecting the vertebrae of the Western Hemisphere and wedding the waters of the Atlantic and the Pacific would have meant undying fame to the engineer in charge. It would have meant fortune as well as fame, for the greatest engineering problems of private individuals, corporations or nations would have inevitably been handed to that engineer for solution. Because the three above named men stepped down from the high office to which they had been in turn appointed by the President and put aside all hope of gathering that endless glory, many have wondered if secrets did not lurk behind their resignations—if there were not especially well concealed engineering difficulties there which Messrs. Wallace, Shonts, and Stevens felt portended disaster and if a De Lesseps-like failure would not be the fate of the engineer on whose shoulders the responsibility would ultimately fall.

Many have so stated it, and have commiserated Lieutenant-Colonel Goetals, who, being a soldier, had no alternative but take up the work when it was assigned to him. Some have predicted failure and when reports were published guardedly that lands were sliding and that material placed on the site of the dam had sunk, those who had pondered on the prior retirements believed that the lid was lifting and that the stench of a vast blunder was about to come forth.

On the day that the Congressional junketing or "investigating" delegation sailed for the Zone an official gave me—with seeming candor and frankness—a

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TIER BY TIER THE EARTH

A VIEW OF CULEBRA CUT—LOOKING SOUTH.

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AND STONE ARE BEING CUT AWAY.

mass of information which, if correct, disposes of all condemnatory conjectures and reaffirms the frequent assertions of the Chief of the Commission that there is no difficulty confronting the Commission which could not be overcome.

"It's true that a portion of the work on the dam foundation sank a short time ago," said he. "On November 21, to be exact. The part that settled was a portion of the rock toe on the up stream end and it settled about twenty feet.

"There was a reason! For several weeks prior to that time there had been a slide under the high trestle of the Panama Railroad which had been moved. That made necessary the dumping of an additional quantity of rock to bring the roadbed to grade.

"During the week of November 15 high water in the Chagres River flooded the tracks of the railroad at Gatun and at about that time somebody sent out an untraced rumor that borings on the dam site had proved that a great subterranean lake existed beneath it.

"That is positively false. The borings showed water in only about one-tenth of the holes—proving conclusively that the water was only in pockets. There was no cause for alarm in that water discovery nor indeed in the bulging up of the earth at the dam site, yet it was the latter happening that caused some people to leap to the conclusion that there was no suitable foundation and that the vast weight of the dam would cause the entire structure to sink.

"As a matter of truth the engineers expected the earth to rise; planned for it so to do, and would have been disappointed and astounded if their plans had not matured. It was at that place that the French engineers had done considerable work in former years; one of their accomplishments having been the cutting of a canal channel which had been closed by the construction of the south toe of the dam. For twenty years silt and soft mud had been collecting at the bottom of the channel and had never been removed. When our engineers began the construction of the south toe thousands of tons of rock were dumped. When its weight became great enough it naturally displaced the soft bottom of the old channel and forced it up 200 feet north of the toe into the site of the dam. But, as I said, that was anticipated and desired. It is also anticipated that other parts of the

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EXCAVATION FOR A SPILL-
It is at Gatun that the famous

toe may settle in the same way. The more the settling the firmer will be the foundation of the toe. The result is the same as though a big trench had been dug across the valley down to the stratum of stiff clay which underlies the dam site, and that trench had then been filled in with stones.

"The work on that dam is not in any way interrupted by these small settlings and rock will be dumped in until the toe has reached the desired height of sixty feet, and every settling will only result in more rock being dumped until the solid foundation has been reached and the equilibrium established.

"For those not familiar with the plans for the dam it may be well to explain what is meant by the toes. This dam, you know, is for the purpose of impounding the waters of the Chagres River and its tributaries in a lake that will form in the valley. The structure will extend from the ridge of hills in the west across the valley to the ridge on the east and will be about one and a half miles long. It is planned to build it by pumping sand and clay upon the site selected until a hill 135 feet above sea level and 1,700 feet wide extends across the valley. Suitable sand and clay have been found in large quantities down the valley of the Chagres convenient to the site and by careful tests have proved to be good material for an earthen dam. The dam itself will be made by suction dredges which will pump the material mixed with water upon the site. The water after running off will leave a closely packed deposit of solid material. For the purpose of adding weight to the dam and for the further purpose of keeping the material from sliding to the north or south, two walls, or, as they are called, toes, of rock are being built across the valley.

"The down stream or north toe is of rock and earth taken from the cut at Mindi and from the site of the locks. The up stream toe is of the hard rock from the cut at Bas Obispo and material excavated from the lock site. The

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WAY AT GATUN.
dam of that name is being constructed

CULEBRA CUT. LOOKING NORTH FROM EMPIRE HILL

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THE PEDRO MIGUEL

EXCAVATION WORK ON CONTRACTORS' HILL

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LOCK SITE.

ridge of Bas Obispo rock is thirty feet broad at the top and when completed will be sixty feet high.

"Between these two toes, which are not part of the dam proper, 3,000,000 cubic yards of the sand and clay will be pumped, the real purpose of the toes being to hold the material of the hydraulic fill until the water has drained off and to make unnecessary the greater fill that would be required if the material were allowed to seek its natural slope.

"If that explanation satisfies your mind as to the construction plans it may be well to dispose of the rumor of a lake beneath the site. I have explained that borings proved the presence of water in only a few of the holes which were sunk. The fact that there was no communication between the holes proves that the water came from pockets and not from a large body of water and the fact that the water was under pressure and rose in the holes proves that it had no outlet.

"In addition to the borings two test pits were sunk 100 feet below sea level. They confirmed what the borings had previously shown—that the dam had been properly placed and that it is being built on a very firm foundation of impervious clay underlying a mass of conglomerate, which in turn is underlaid by a stratum of argillaceous sandstone.

"Whether these explanations will satisfy the sensation-hungry ones who look for the downfall of the Commission's plans I don't know, but they are explanations of the actual existing conditions and I believe should convince even the most pessimistic that the men who have the vast task in hand are amply able to cope with all difficulties and to do what the American people look for them to do—cut that canal and have it ready for ships to go from Ocean to Ocean through by January 1, 1915."

John F. Stevens, formerly chief engineer of the Panama Canal, in a published letter defends the Gatun Dam, declaring there is no justification for the sensational reports attacking its design, which recently have been circulated.

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THE PRODUCTS OF ONE-ACRE RANCHES ARE VARIED AND PLEASING TO LOOK UPON.

WHAT ONE ACRE WILL DO

By F. G. MOORHEAD

"I SEE no reason why a woman cannot earn as good a living on a small farm as in any other field."

Such is the assertion, made with the cheerful certainty of one who has tried it—and succeeded—by a Connecticut woman, Mrs. Jane C. Barrow, who has for the past eight years supported herself and sent two children to school, on the earnings of a four-acre farm, only one acre of which is available for planting and buildings.

"If a woman is as fond of the country as I am," Mrs. Barrow says, "she will not find it a hardship, but rather a pleasure. I had everything to learn and I have succeeded, so I think other women could do as well. I began with a small boy as assistant; now I have a woman and a man and we are all three kept pretty busy."

When this energetic and courageous woman took her land she was forced to go into debt for money to pay for groceries enough to keep her and the two children until the farm began to make returns. How she worked out and solved the problem is best told by herself.

"I had bought with the farm thirty stands of bees and there were just one dozen choice currant bushes. That was my whole stock and I cannot say that the outlook was very encouraging. With a part of the borrowed money I bought five ducks and one drake, one setting of white Wyandotte eggs and six pairs of pigeons.

"In the past year, I raised on one-fourth of one acre that I devote to poultry, bees and small fruits, over one thousand ducks. They were sold when between three and four months old. They averaged in weight about four pounds, and my whole crop of feathers was about 400 pounds. Every duck was ordered before it was hatched and I am sure I could have secured orders for as many more had I been able to supply them.

"On the other three-quarters of my acre I now have 600 currant bushes, fifty raspberry bushes, 100 white Wyandotte chickens, twenty-four white Holland turkeys, sixty pairs of pigeons and seventy-five stands of bees. The bees and the currant bushes are the increase of

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those bought with the place. The currants were increases by saving the prunings and planting them as cuttings. Perhaps I should add that I have from time to time sold several dollars' worth of the young plants.

"The chickens are all from that one setting of eggs, with the addition of three new roosters. In the past year I sold off forty-two broilers and seventy-two grown chickens. From my pigeons I sold 400 pairs of squabs and a few pairs of the old fellows for breeding.

"While I have been fairly successful with pigeons I have made much more money on ducks and find them easier to dispose of. My turkeys are a venture of only four years' standing, but, so far, have proved almost as remunerative as the ducks. There is a ready sale for every pound of feathers and down from a white turkey. I have almost decided there is more profit raising the white turkeys than any other fowl for the market. I see no reason why a woman with a piece of land large enough should not be able to raise a thousand turkeys and have them all as good as my few dozen. That is where money is to be made on farms around New York, Boston, Philadelphia, or any other large city."

A few years ago a Montana rancher found himself in possession of two acres of unirrigated land, on which the average dry-farming yield was about thirty bushels of wheat every other year, the annual revenue when wheat was a cent a pound in Montana being eighteen dollars.

Near by was an unsightly bog caused by a spring, the natural channel of which had become filled up. It occurred to the rancher that the outlay of conducting the waste water to his two-acre ranch might be justified. He set to work to remove the earth and the mud just below the spring and form it into an embankment. A reservoir of irregular shape was made. The discharge of the spring in summer was about nine gallons per minute. The reservoir held 162,925 gallons. On account of the loss due to seepage and evaporation it took fifteen days to fill the reservoir.

By means of a six-inch sewer-pipe and an irrigation ditch the spring-water was conveyed to the arid land, the outlay being but $112 for everything involved, excavation, sewer-pipe, concrete, wooden

A FARM OF JUST ONE ACRE IN THE PACIFIC NORTH-WEST.

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WHERE AN OLD COUPLE MAKE A GOOD LIVING ON TWO AND ONE-HALF ACRES.

laterals, spaced fifty feet apart.

The returns for the season at the end of the third year from plantings were:

Red clover, 2¾ tons, from 6 cuttings, at $6......	$ 16.50
Apples, beginning to bear	0.00
Crab apples, beginning to bear..............	0.00
Strawberries, 2,500 quarts at 7 cents............	175.00
Raspberries, 1,500 quarts at 10 cents...........	150.00
Dewberries, 1,000 quarts at 10 cents...........	100.00
Gooseberries, 200 quarts at 5 cents............	10.00
Currants, 300 quarts at 7 cents................	21.00
Total,	$472.50

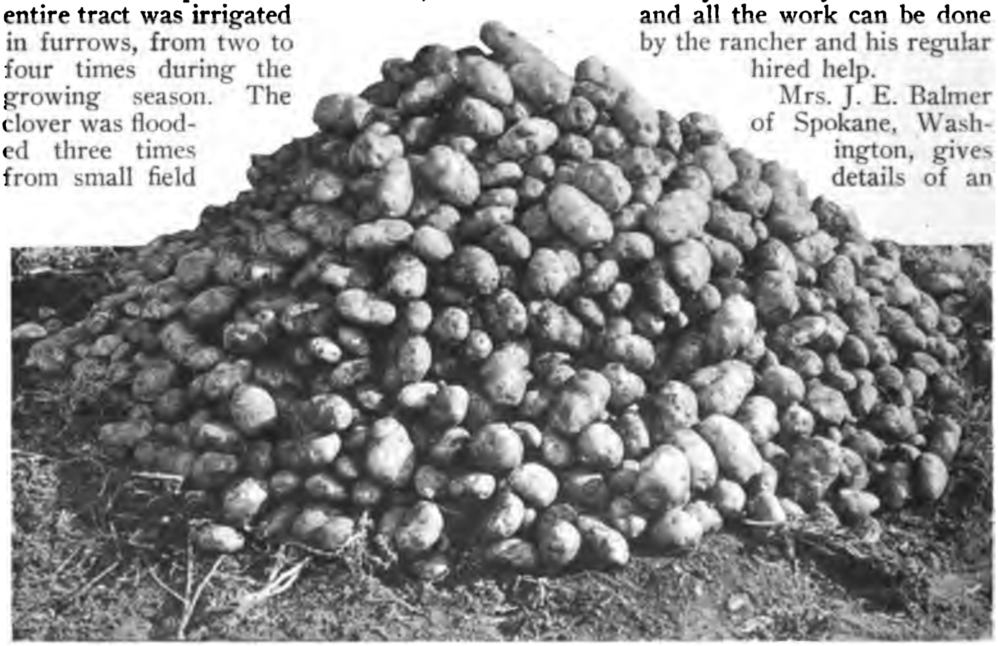
box and foot-bridge, labor and incidentals.

One-half an acre of the newly watered land was then planted to red clover, one-half to Yellow Transparent, Duchess and Wealthy apple trees and Transcendant crab-apples. One-third of an acre was planted to strawberries, one-third to raspberries, currants and gooseberries. With the exception of the clover, the entire tract was irrigated in furrows, from two to four times during the growing season. The clover was flooded three times from small field

The land had paid for the outlay four times over in one year, each acre producing twenty-six times what it had before irrigation.

In a country with the topography as varied as that of the Rocky Mountain states, springs are numerous and there is abundant opportunity to utilize them, while with the exception of the piping, cement and a small amount of lumber, there is no outlay necessary for material, and all the work can be done by the rancher and his regular hired help.

Mrs. J. E. Balmer of Spokane, Washington, gives details of an



THESE POTATOES COME FROM LAND WHICH TURNS OUT A CROP WORTH FROM $150 TO $800 PER ACRE.

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extraordinary experience with a one-acre farm. The word extraordinary is used, not because the possibilities of the piece of land involved were so, but because the use made of it was remarkable. Strict account was kept of the business from January 1, 1907, to January 1, 1908.

She began the year with 170 White Leghorn hens. During the twelvemonth, she sold 22,079 eggs at an average of thirty-six cents a dozen, or three cents each, making a total of $662.37; hatched and raised 1,300 chicks, from which she sold 640 broilers at fifty cents each, making $320. At the end of the year she had 540 pullets and twenty cockerels, for which she could get on the local market for breeding purposes, $580. Her grand total was, therefore, $1,562.37. She paid $440.76 for feed and used 172¼ dozen eggs for hatching, at thirty-six cents a dozen, or $61.95, making a total expense, aside from labor, of $502.71. The net profit was, therefore, $1,059.66 for the year's work.

A Four-Year-Old Royal Ann Cherry Tree, Such as This, Will Net From $20 to $50 a Year.

An excellent example of success in the Mississippi Valley is along the same line. George W. Hodges, a traveling salesman for a house in Kansas City, cleared in one season $150 from a tract of ground 180 by 272 feet, a little more than one acre. His eighteen-year-old niece assisted him and together they took care of the tract and did all the work upon it. Mr. Hodges himself devoted but an average of one hour each day to the work. The total outlay was but eleven dollars, divided for plowing, onion sets, tomato plants, radish seed, turnip seed, beet seed, beans, okra seed and mustard seed. Of all the profit, $72.50 was netted from the beans, which paid by far the best of all the things planted. The family of three used all the vegetables necessary for the table during the season, besides "putting up" corn and pickles and twenty-five quarts of tomatoes.

Plenty of wonderful tales of marvelous crops from the irrigated lands of the Northwest have been told and printed, but some of the following are among what may be called the moderate successes, as the figures are not records, except in one or two cases. From one acre, farmers of the great Northwest have secured the following results: Apples, $2,200; pears, $1,700; peaches, $1,400; cherries, $1,200; grapes, $1,000; cranberries, $825; strawberries, $750; raspberries, $250; prunes, $125. Of vegetables, the following are the astonishing figures: Tomatoes, $700; cabbage, $600; cucumbers, $520; onions, $500; canteloupe, $400; cauliflower, $400; peas, $300; celery, $300; carrots, $300; potatoes, $165; pumpkins and squash, $100. Wheat, corn and alfalfa average $50 per acre in this land of plenty.

As for record yields, they run much higher, and it is about the record crops that we have heard most. Pears have

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been known to run far higher to the acre of trees than the figures above quoted, until, in fact, the tales have seemed to border on the fabulous. But for the average man, these showings are good enough. It is what can be done for a living all the year round and every year, with a fair percentage of luck, that est average for the state of Washington for the past ten years has been 151 bushels, and the general average 124 bushels. Sometimes thirty to forty good, well-grown potatoes have been found in a hill, where proper care has been given them. Proper care has been the secret of all the wonderful records, but the

THE BEGINNINGS OF AN ORCHARD—PLANTING THE FIRST TREES.

the farmer is interested in, and not in what may be done for fair or exposition time, or as a record for a county or a state. Apples have brought $1,000 to the acre and pears have netted $2,600 from half an acre. One record of $1,806.75 was made from apples in a certain famous irrigated section. Perhaps the average farmer may wish to look at these figures as showing the possibilities in the way of special prizes for special care, but, for the average year's yield he will be glad to dream of having far less.

The world's record for potatoes is a thing of interest, however. R. J. Hurd, a rancher on the Little Spokane River, grew 800 bushels of Burbanks from one acre, in 1908. Three other acres on the same patch averaged 533 1-3 bushels. One hill contained thirty-two potatoes, weighing twenty-two pounds. The high- term means much. But the fact that the farmer of America is demonstrating every year that the real productiveness of the land has never been known, is an encouraging one to the small holder, or to the man or woman who looks upon farming as a calling with a longing eye.

Robert Sleicher, of Lewiston, Idaho, reports the expense of raising and packing grapes at $75 per acre, the actual profits at $400. Charles Lambert, of Lewiston-Clarkston Valley, sold three tons of grapes from 245 vines, on one-third of an acre, at $70 a ton, or $210 total. J. H. Nave, of Lewiston-Clarkston Valley, took 1,500 crates from 1,000 vines on one and a half acres, selling them for $1,500, or $1,000 to the acre. Wm. Lee, Jr., of North Yakima, Washington, sold five tons, or 12,500 baskets from three acres; an average of $625

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to the acre. Among the big records are those of O. C. Haggart, of Spokane, who sold $60 worth of strawberry plants, $200 first-crop berries and $100.80 second-crop berries; a total of $360.80 from one-third acre. J. M. Jackson sold $165 worth of strawberries from a quarter acre. Charles Ayres sold $750 from one acre. A. J. Wilson sold $600 from one acre.

Charles Ayers, of Spokane, raised 200 crates of raspberries on one acre, selling them at an average price of $1.25; a total of $250.

A. C. Carter, of Spokane, sold May Duke cherries for fifteen cents a pound, netting $48 per tree. The trees can be planted eighty to the acre, a total at this ratio of $3,840.

Roy Bates, of Dallas, Oregon, from seven and a half acres of prunes realized $950, receiving $4.27 per hundredweight, an average of $125 per acre.

E. V. Martin, of Wenatchee, sold 2,800 boxes of tomatoes from one acre, a net profit of $700. Mrs. Edith Coatney, of Spokane, sold $175 worth of tomatoes from a quarter acre, doing the picking and packing herself. S. A. Wright, of Spokane, sold $635 worth of tomatoes from one and three-fourths acres, an average of $360 to the acre.

J. B. Wolfe, of Union, Oregon, picked 1,200 sacks of onions from three acres, selling them for $1 a sack, a total of $400 per acre. In 1897 he sold the crop for $1,500, an average of $500 per acre. E. V. Martin, of Wenatchee, from two and a half acres of Yellow Denver onions realized $900, or a little over $375 per acre.

John Arrowsmith, of Kent, Washington, in 1907, from one and one-fourth acres sold $670 worth of cucumbers, netting $520. In 1908, seventeen acres yielded $8,840, with a clear profit of $6,620. Gross $520 per acre.

Frank Jordan, of North Yakima,

WATERMELONS GROW BIG.
Irrigation flume is shown in background.

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planted one-third acre to cabbage and reaped fifteen tons, bringing in $600. The heads averaged twelve pounds, one weighing thirty-one pounds. A more average yield is that of J. F. Strong, of Spokane,—fifteen tons or $600 to the acre.

R. R. Pinkerton, of North Bend, Oregon, realized 300 bushels of cranberries to the acre, selling them for $2.75 a bushel, a total of $825 for the acre.

A yield of 23,000 canteloupes to the acre is reported, the average being from 200 to 500 crates, selling for fifty cents to $1.50 a crate. Squash and pumpkins yield from 100 to 300 dozen to the acre and sell from seventy-five cents to $1 a dozen, an aggregate of $100. Carrots yield from twelve to fifty tons to the acre, an aggregate of $300, approximately the same as peas, with cauliflower a little better.

These reports are vouched for by the Chambers of Commerce of the leading cities of the Pacific Northwest and are by no means exceptional or isolated. They may be duplicated probably in other parts of the country, the testimony showing that whether the acre is located in Montana, Connecticut, Washington or Missouri, its productiveness is such that had Cleon tilled his million acres as do the small ranchers and farmers of today Croesus would have been put out of the running altogether.

POTATOES DUG FROM ONE HILL ON A FOUR-ACRE RANCH NEAR SPOKANE.
This land produced 800 bushels to the acre.

Love

O Love! what hours were thine and mine,
In lands of palm and southern pine;
In Lands of palm, of orange-blossom,
Of olive, aloe, and maize and vine.

—Tennyson.

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IN THE SURGICAL DISPENSARY OF ST. GREGORY'S HOSPITAL, NEW YORK CITY.

MARVELS OF MODERN SURGERY

By C. F. CARTER

THE layman who attempts to keep himself informed concerning the wonders of modern surgery thereby subjects his credulity to such fearful strains as may be expected to bring him to the operating table, where he will be able to gather unwelcome impressions on the subject at first hand. At least, if a rupture of the credulity can not be operated upon it is about the only thing that the surgeons of the new school have not tried to mend, and tried successfully, too.

Some of the things that the most gifted of the modern surgeons have accomplished seem to smack of the miraculous rather than of the plodding precision of Science. So well has the mechanism of the living body been mastered that the surgeon now sets about his delicate tasks with all the assurance of success with which a good machinist would undertake an ordinary job of repairs. The surgeon has become a mechanic in flesh and blood.

Indeed, the advance guard in the field of experimental surgery has arrived within sight of the time when worn out, broken down wrecks of humanity can be sent to the operating theater for a general overhauling just as a battered locomotive is consigned to the back shop to be rebuilt. The family physician of the

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near future can be pictured in the mind's eye making out a work sheet for the guidance of the surgeons to accompany a hypothetical patient to the hospital which might read something like this:

"Amputate rheumatic right leg and graft on a new one.

"Cut out kidneys, which are developing Bright's disease, and transplant sound ones, preferably from a healthy young hog.

"Reverse circulation of the blood in the thyroid gland to produce hyperaemia and thus reduce diseased condition.

"Overhaul the intestines and patch where needed. The rest of him is hardly good enough to stand the expense of a new set.

"Overhaul circulatory system, replacing unserviceable veins and arteries with new ones. Put in a new heart only if absolutely necessary.

"Cut out stomach. It is completely worn out and has a well developed cancer. Besides, he won't have much use for it hereafter, as it will take all his earnings for a long time to come to pay his hospital bill.

"Cut out left lung. It is so far gone with tuberculosis that it is good for nothing and only endangers the rest.

"Trim off fifty or sixty pounds of fat. With reduced stomach and lung capacity he can't carry so much ballast.

"Make all minor repairs needed to keep him going for ten or twelve years more."

Nonsense, say you?

Not a bit of it. Perhaps no one man could stand it to have quite all these things done to him at one time, but the surgeons could do their part all right. They know they could, because they have already performed all these seemingly impossible feats and a great many more besides.

Unbelievers may find at the Rockefeller Institute for Medical Research in New York some living circumstantial evidence in support of these staggering assertions.

One of the living documents is a fox terrier which runs about on three legs of his very own and one which formerly belonged to another terrier. The fourth leg was grafted on to its new owner more than a year ago. So far as can be observed the terrier can not tell which legs he brought with him into the world and which one he has since acquired; for the new leg is perfectly sound and performs its function like any other healthy leg.

The particular chum of this fox terrier is a cur who hears the call to dinner through an ear which, with its surrounding area of scalp and skin of the neck and underlying lymph glands and parts of the carotid artery and jugular vein, once belonged to another dog. Neither the present owner nor any one else could tell that the ear is a recent acquisition if it were not for its color, which is in sharp contrast with the majority of the cur.

Dr. Alexis Carrel, the surgeon through whose assistance the terrier achieved the distinction of being the first living creature to wear a grafted limb, began his experiments in transplanting legs more than two years ago. At the first attempt he amputated the hind leg of a dog below the middle of the thigh, then, after a few minutes, replaced it, carefully sewing blood vessels, muscles and the sciatic nerve together and holding them firmly in place with a plaster bandage. It was just one hour and a quarter after circulation was interrupted in this intricate and delicate operation before it was restored again. In a short time the dog was walking on three legs and eating and drinking as if nothing had happened.

As everything appeared to be all right the plaster bandage was removed at the end of ten days. Unfortunately the bandage had slipped, permitting the wound to become infected, so the dog had to be killed. It was found that the skin, muscles and nerve had grown together just as in any ordinary surgical wound and that the bone was beginning to unite. There were several more failures before the technique of the operation was mastered and success crowned the efforts of the surgeon. Dr. Carrel's success in these experiments led him to make this statement before the Johns Hopkins Hospital Medical Society:

"There is no reason why a leg or an arm can not be transplanted successfully on a human being. For instance, the transplanting of the arm a little above the elbow may succeed perfectly if an

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adequate technique is used in the operation.

"In fact, the transplanting of a limb of an animal to another of the same species is very much simpler than the transplanting of a gland. It is well known that the circulation of a limb can be stopped completely for several hours by the Esmarch bandage without subsequent difficulties. The skin, muscles and bones are not very sensitive to slight modifications of the serum, and the blood of the new owner would not be toxic for them."

Dr. Carrel declares that the chief difficulty in the way of transplanting limbs on human beings is to obtain the material. As one source of supply he suggests that the limbs of executed criminals, or of persons killed by accident might be utilized.

In his own estimation the transplanting of a leg is by no means the most remarkable feat achieved by Dr. Carrel. This wizard of surgery is a Frenchman on the sunny side of forty with all the suave courtesy which tradition ascribes to his race and energy enough for half a dozen men. He first attracted attention at the University of Lyons by his experiments in transplanting kidneys in 1902. In these he divided honors with Dr. Ullman, though neither knew what the other was doing at the time. Dr. Carl Beck, of Chicago, tried the same thing in the following year.

Not finding opportunities to his liking in his native land Dr. Carrel went to Chicago. At the physiological laboratory of the University of Chicago he undertook with Dr. Guthrie a series of experiments that to characterize as astounding sounds altogether too tame. They transplanted from one animal to another kidneys, suprarenal glands, intestines, hearts, lungs, thighs, ovaries and the whole portion of the body below the diaphragm.

In order to find something to take the place of the oesophagus in case that organ should be destroyed the surgeons transplanted a section of intestine into the neck of a dog and made it grow in place. In another instance they transplanted a

ADMINISTERING ETHER. PREPARATORY TO AN OPERATION.

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section of intestine on the walls of the jugular vein and carotid artery. In twenty minutes after the operation was completed peristaltic movements were observed in the segment of intestine, thus showing that it was receiving its regular supply of blood and would live.

CUTTING OUT A SECTION OF BONE FROM A FRACTURED SKULL.

The heart was transplanted in several different ways. In one experiment the heart of a small dog was attached to the cut ends of the jugular vein and carotid artery in another dog. Circulation was restored in an hour and a quarter. Soon the auricles of the transplanted heart began to contract and an hour after the operation the ventricles began effective contractions. Thereafter the heart beat regularly 88 times a minute while the normal heart beat 100 times a minute.

This would seem to be doing pretty well, but the pace wasn't swift enough for Dr. Carrel, so he found an opportunity to join the staff of the Rockefeller Institute for Medical Research which was created for the sole purpose of increasing the sum of knowledge of the healing art. Here the experiments in the difficult feat of transplanting kidneys were resumed.

In early experiments Dr. Carrel and others had tried to graft kidneys into the necks of animals, the object being to ascertain first if it was possible to restore circulation in the transplanted organ and thus cause it to resume its functions. Succeeding in this at last Dr. Carrel next tried to transplant a kidney in its proper place and with the proper connections.

Progress with the naked kidney not being satisfactory the surgeon next tried to transplant both kidneys with their surrounding tissues, segments of the arteries and veins, nerves, ureters and flap of the bladder. In the first experiment the cat on which it was tried lived four days. By the time the sixth experiment was tried the technique of the process had been so much improved that the cat recovered perfect health, became fat, ran about, climbed and jumped and ate heartily. But a month later something went wrong with the grafted kidneys and death ensued.

In every one of nine experiments the functions of the transplanted kidneys were restored within twenty-four hours, and sometimes before the operation was completed. Death in every case resulted, not from the failure of the kidneys to perform their functions, but from some difficulty arising from so complicated an operation. But Dr. Carrel persevered until he succeeded in getting a cat with transplanted kidneys to live eight months. As two dogs out of five in which Dr. Floresco transplanted kidneys lived in good health it would seem to be pretty well established that kidneys can be transplanted successfully if the surgeon only possesses the necessary skill and dexterity and maintains perfect asepsis at every stage of the operation.

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The hopeless sufferer from Bright's disease may, therefore, be able to cheat death, after all, if he can only find a pair of healthy kidneys to take the place of his diseased ones. Dr. Carrel suggests that in exceptional cases it might be possible to use the kidneys of a man killed by accident, though the ideal method would be to transplant on man organs of animals easy to secure and operate on, such as hogs, for instance.

"The future of the transplantation of organs," declares Dr. Carrel, "depends on the feasibility of heterotransplantation."

Heterotransplantation, or the transplantation of organs from one species of animal to another, has been regarded in the past as impossible, because the serum of one species was believed to be deadly poison to all other species and there seemed to be no way to neutralize this poison. Hoepfner, of Berlin, tried heterotransplantation a few years ago, but failed. Dr. Carrel, however, in his experiments at the Rockefeller Institute, has been successful not only in this but also in the almost unexplored field of surgery of the blood vessels. In December, 1906, he exhibited before the American Physiological Society a cat into which a segment of the carotid artery of a dog had been grafted after having been kept in cold storage for a week. At last accounts, a year and a half after the operation, the cat was in perfect health. He has also succeeded in grafting a segment of artery from a human being into a dog which lived in good health afterward. As Stich and Makkas afterward were entirely successful in grafting segments of arteries from rabbits and cats into dogs and from human beings into dogs, and as Dr. Guthrie, of Chicago, has also grafted rabbits' and cats' arteries into dogs, the feasibility of heterotransplantation would seem to be fairly well established.

But as in practice a section of vein or artery of the right size might not always be available at the right moment to save a human life the next step was to find out whether the up-to-date surgeon could not keep an assortment on hand. So Dr. Carrel cut a segment of carotid artery from a dog thirty-five minutes after death and preserved it in a tube of Locke's solution in cold storage. Eight days later he transplanted it in the left carotid of a dog. Two months later the dog's neck was opened and the transplanted section was found to be practically indistinguishable from the rest of the artery. Experiments along this line were continued until the fact had been fully established that arteries could be kept in cold storage for any period up to sixty days and transplanted successfully, and that the results of the transplantation more than a year afterward were entirely satisfactory.

The wonder of this operation may be better appreciated if it is borne in mind that surgery of the blood vessels is exceedingly difficult under most favorable circumstances. It is well known now that all surgical operations must be rigidly aseptic; but asepsis which may be satisfactory for other operations is not good enough for surgery of the blood vessels. Nothing short of perfection will answer.

Then too, the blood vessels, particularly the veins, are very delicate. They must not be crushed or even roughly handled with metallic forceps or other hard instruments. In transplanting Dr. Carrel used no clamps nor forceps but closed the ends with narrow strips of linen held in place by small forceps. The grafts were sewn in place with very small sharp needles and thread sterilized in vaseline. Great care is necessary to bring the ends exactly together and to prevent any fragments of the connective tissues from getting into the artery or vein where it would infallibly cause a clot with the most disastrous consequences.

Having mastered the art of transplanting blood vessels Dr. Carrel went a step farther and demonstrated how a frugal man might have his worn out veins and arteries patched if he did not want to go to the expense of entire new sections. He has patched the abdominal aorta of a cat with perfect success. He also cross grafted one end of a vein into an artery and the other end of the artery into the other end of the divided vein so as to reverse the direction of the circulation of blood just as a mining engineer sometimes reverses the currents of air in a mine to clear out dangerous accumulations of gas.

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Of course the object of all these experiments on animals is to ascertain first if they are feasible, and second, how to do them just right in order to apply the knowledge thus gained to the saving of human life. No other way is open to the surgeon, for he cannot experiment on human beings. The applicability of the experiment last mentioned is illustrated by the fact that it has been tried three times in Europe on human beings to stop gangrene and failed in each case because the surgeons only succeeded in turning the arterial blood right back into the heart instead of into the capillaries where they wanted it to go. Dr. Carrel achieved perfect success in reversing the circulation in the femoral artery and vein, the main blood vessels of the leg, but doubts its utility as a treatment for gangrene.

Even more spectacular are the researches in resuscitation being conducted at the Rockefeller Institute with the object of ascertaining how long after apparent death the spark of life may be fanned into a glow. It is believed that the heart continues to beat, very feebly to be sure, yet strong enough to maintain a circulation that keeps the tissues alive for minutes and perhaps hours, after the physician is unable to detect it by any outward sign. Resuscitation is easiest after asphyxiation, more difficult after anaesthesia, still more difficult after hemorrhage and most difficult after electrocution.

IN THE SURGICAL WARD.

The last desperate expedient of the surgeon after all other means have failed to revive a patient, is massage of the heart through an incision in the abdomen. It was first tried in 1882. Forty cases have been reported in which massage of the heart has been attempted. In two additional cases last summer in Greater New York it was tried with success, but the patients died in from forty hours to four days afterward from the original causes of suspended animation. Lesas tried massage of the heart in ten cases of collapse from the effects of chloroform after all other restoratives had proved useless and no other hope for the patient's life remained. Two cases were total failures, in two other cases the heart beat a short time and in six cases the patients recovered.

It is amazing to find what the heart will stand when manipulated by the

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skilled hands of the modern surgeon. In a series of 128 cases in which wounds of the heart were sewn up forty-seven patients, or more than a third, recovered. In another series of 124 cases in which the chest was opened and the heart sewn up twenty-four recovered.

The staff of the Rockefeller Institute has no monopoly of brilliant achievements in experimental research. Dr. George Crile, of Cleveland, has performed a notable service by perfecting the methods for transfusion of blood. Previous to Dr. Crile's success it was held that the great danger and difficulty of transfusion quite outweighed any advantages that might thereby be gained, and the operation, therefore, has been extremely rare.

Dr. Crile invented a thimble by means of which the inner walls of the artery of the donor and the vein of the recipient could be brought into perfect contact, thus eliminating the danger of the formation of clots. His methods of operation obviate other difficulties. But no fewer than 225 experiments were made before the surgeon ventured to try his methods on a human being in his clinic. Since then he has made thirty-two transfusions of blood from one human being to another with perfect success, and without pain.

A striking instance of the value of Dr. Crile's researches is afforded by the case of a woman who was apparently doomed to death unless a certain operation could be performed, yet who was too weak to stand the operation. Her strength was re-enforced by a transfusion of blood from her husband's arteries, thus enabling her to withstand the shock of the operation and she recovered.

A DIFFICULT OPERATION.

Dr. Samuel Robinson, of the Harvard Medical School, is another pioneer in a new and unpromising field—operations on the lungs. Heretofore such operations have been regarded as too dangerous to be undertaken, for if air is allowed to enter the pleural cavity and remain the

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result is a collapse of the lungs, followed by disturbances of the nervous system, circulation and respiration, resulting in death.

To prevent this fatal collapse of the lungs while operating upon them Dr. Robinson has invented a "positive pressure apparatus" by which the lungs are kept artificially inflated by compressed air. In a series of thirty experiments on dogs in which the positive pressure apparatus was used and in which the operation consisted in removing one or two ribs and from a third of a lobe to a whole lobe of the lungs, there were twenty-one complete recoveries.

Equally remarkable results are achieved in operations on the abdomen. Until some years after the civil war a wound in the abdomen was almost certain to be fatal. But recently surgery has made such marvelous progress that it seems almost impossible to inflict a fatal wound in the abdomen if the victim is within convenient reach of a competent surgeon. In the summer of 1908 Dr. M. L. Harris, of Chicago, performed operations in seventeen cases of gunshot wounds of the abdomen in which there were from one to eight perforations of the intestines and every patient recovered.

A picturesque instance of the incredible amount of carving and pawing and prodding that the abdominal viscera will endure with impunity under modern aseptic surgery is afforded by the case of a professional glass eater who after a career of twenty years was obliged at last to go to a hospital for repairs. The surgeons cut him open in June, 1906, and extracted 52 nails and a large assortment of broken glass and other rubbish. He resumed business, but had only swallowed seven nails when he had to return to the hospital.

This time the surgeons found the intestine nailed fast by a twenty penny nail, the head of which was in the intestine and half an inch of the point firmly embedded in the wall of the abdomen. Two other nails were also removed. Although the surgeons carefully overhauled the whole digestive apparatus this time they could find nothing else and the patient after an uneventful recovery was discharged.

But he was soon back again. For the third time the surgeons laid his abdomen open and were rewarded by finding a mass of twenty-eight corroded nails embedded in inflamed tissues behind the stomach from which they had escaped by perforations. After all this the man recovered. But he has foresworn hardware as an article of diet.

However, the average man can never hope to be the hero of any of these spectacular feats in surgery. He will be more interested to learn, therefore, that in the simpler and more common surgical operations quite as great progress has been made as in daring reconnoissances in experimental research. Out of 422 surgical cases in Fordham Hospital, New York, in the summer of 1908, there were thirty-nine deaths; but as twenty-four of these occurred within twenty-four hours after the patients were admitted they evidently had little, if any, chance for life. Excluding these and leaving only those in which the surgeons had a fair chance to exhibit their skill, the death rate was but 3.5 per cent.

Although there are 5,500 deaths from appendicitis annually in the United States, the death rate in the cases operated on is only about two per cent.

There is an annual average of 9,000 deaths from cancer of the stomach; yet Dr. J. W. Mayo has so perfected the technique of the operation for this dread malady that in eighty-one cases the death rate was fourteen per cent and in the last twenty-five cases only four per cent. One-fourth of the survivors were living three years after the operation. Dr. Vassalo, of Buenos Ayres, once removed the entire stomach in a bad case of cancer in an operation lasting thirty-eight minutes. Four months later the patient was in excellent health, free from pain and able to digest food without difficulty. The same surgeon removed parts of the stomach in seventeen cases and all but one of the patients recovered.

Surgeons are growing more careful, too. Sometimes they used to leave instruments, compresses and wads of gauze in the bodies of their patients. In one case a pair of forceps five inches long was left in a woman's abdomen for ten years before it was discovered and removed. In another case a pair of forceps absent mindedly sewn up in a pa-

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tient worked its way into the bladder from whence it was removed eight months later. To guard against further inadvertences of this kind a German surgeon has invented a method of attaching all instruments by tapes seven feet long to the wire basket in which they are sterilized. An American surgeon supplements this by inventing a bag holding ten yards of gauze which is pulled out as needed and allowed to drop into a jar after use without being cut off. Thus there is no chance for pieces to be left in the midst of the patient.

Most practical of all progress is that which has been made in the methods by which perfect cleanliness is insured in operations. The most trifling cut may be fatal if the wound becomes infected, while the most formidable operations lose most of their peril if perfect asepsis is secured. Dr. Doyen, the great Paris surgeon, removes his street clothes and swathes himself in sterilized robes before performing an operation and requires his assistants to do the same. The patient is sterilized with the same scrupulous care. Thin rubber gloves cover the surgeon's hands and arms, while a germ proof mask prevents his breath from coming in contact with the wound.

Instead of keeping a broken limb perfectly motionless, thus leaving it practically useless for weeks after the bones have united, it is now the practice to massage the injured member daily. This not only hastens the union of the bones but it facilitates the absorption of blood and serum, restrains the formation of adhesions and prepares the limb to resume its functions almost as soon as the bones are united.

Dr. August Bier, professor of surgery at the University of Berlin, goes still farther than this, for he does all he can to increase artificially redness, swelling and heat, three cardinal symptoms of inflammation that the profession has always tried to avert. Dr. Bier declares the use of ice bags and elevation of injured limbs to check circulation are merely aids to destruction, and the use of tubes and wicks to drain abscess cavities relics of barbarism. He uses the cupping glass instead.

Whatever may be the nature of the calamity which necessitates the attentions of a surgeon, the patient in 1909 is assured of a degree of immunity from suffering and a prospect of recovery that would not have been deemed possible a few years ago.

Folly

Where lives the man that has not tried
How mirth can into folly glide,
And folly into sin!

—SCOTT.

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THE APPARATUS FOR LURING AND DESTROYING THE BUTTERFLY PEST.
The principal parts are two electric search-lights, with dispersing mirror, suction fan and collection box.

CATCHING BUTTERFLIES BY THE TON.

By DR. ALFRED GRADENWITZ

BERLIN CORRESPONDENT TECHNICAL WORLD MAGAZINE

THE caterpillars of a certain kind of night butterfly, called "nuns," have wrought enormous devastation during the last few years in the fir woods of Germany and other Middle European countries, where many thousands of acres have become a prey to the voracious insect, necessitating the hurried felling of many millions of cubic feet of wood.

In combating this dangerous foe of the forests excellent results have been obtained in the course of the past year in the city of Zittau, Saxony, where electric lamps have been used as insect traps.

Experience had long shown these butterflies to move about with special liveliness during the middle hours of the night, viz., from ten to one o'clock, being specially subject during this time to attraction by light. The night gleam of cities, lighted railway trains, etc., have been repeatedly found to determine the tracks followed by these dreaded butterfly swarms.

After testing a number of illuminants, the administration of forests of the city of Zittau ascertained that only the most intensive light is bound to exert any special attraction on those butterflies. Whereas, ordinary wood fires were hardly effective, acetylene, magnesium, and especially electric light, would exert quite extraordinary effects. Whenever

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gas lanterns were burning in the neighborhood of electric lamps, nearly all the butterflies would fly towards the latter. Quartz lamps with their bluish light, whenever there were butterfly swarms about the towns, would always be the favorite haunts of large numbers.

The problem now was, how to attract suitable amounts of butterflies out of the woods by an intense beam of light, and then to destroy by a special apparatus, the insects fluttering round the lamps.

The following outfit was arranged by Herr Weisswange in conjunction with the city electricity works.

On the falling of dusk all the electric street lamps of the lighting system, as far as possible, were used without any globe so as to act by a specially intense beam on the woods some distance away. The butterflies attracted by the gleam and fluttering against the lamps would partly come into contact with the incandescent carbons, and after being scorched would fall to the ground. However, this process definitely destroyed only part of the butterflies, while numbers of them continued to flutter round the flames. At 11 o'clock these street lamps which, so to say, served only as preparatory and accessory means, were cut out entirely, and the following extensive installation was set working.

Huge searchlights of about forty amperes each were erected, throwing their enormous light beams on the parts most frequently visited by insects of the neighboring city forests. These searchlights were found to exert an intense attraction.

The butterflies were then destroyed by an exhaustor—fan—installed in the immediate proximity of each of the searchlights. A piece of wire gauze mesh was stretched out in front of the discharging opening of the exhauster and the butterflies on being thrown against this, would break their wings.

A point of special importance was to ascertain suitable elevated points for installing the electrical apparatus, whence the most infested forests could be lighted as well as possible. Those selected, comprised the roof of the city electricity works, the tower of the city hall, the roof of a municipal school and that of a factory.

The action of the insect traps was most interesting to watch on those days on which these were specially effective. After some time had elapsed the butterflies would come fluttering along sparingly at first, but in ever increasing numbers, until thousands and thousands, attracted by the brilliant light as though by some magnetic force, would be swarming about in the light's beams.

On arriving at the end of their migration their destruction would be unavoidable as the exhaustor working there without interruption would seize any insects approaching its huge funnel, with a powerful air current, and, after numberless revolutions, throw them out of

ANOTHER VIEW OF THE APPARATUS

the apparatus against the wire sieve, there to meet with their death. Not only the roof and the walls of the building but the persons engaged in operating the apparatus or observing that unwonted spectacle as well, would be entirely covered with butterflies killed or broken down. Some men were busy continuously killing those butterflies, which in the neighborhood of the apparatus, were clinging to the floor and walls by means of twig brooms, in order to sweep them together into boxes and bags.

It is interesting perhaps to note that this process should not have been of equal effectiveness every day. While excellent results were obtained sometimes, at a single point, as many as 400,000 butterflies sometimes being destroyed, the apparatus was found of little avail on certain days. Brilliant moonshine, cold air and heavy wind blowing against the insect swarm were found to

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be drawbacks to the success of the process, while moderate slow rains did not seem to interfere appreciably with its working, and heavy weather indicating storm even seemed to favor the attracting of insects. The main influences, however, seem to be temperature and wind. Whenever the thermometer in the evening dropped below 51 Fahrenheit, the success was generally unsatisfactory, whereas of a warm quiet night at temperatures of 55 to 60 Fahrenheit, with covered sky, the insect swarms were extremely plentiful.

Female butterflies frequently were even more intensely attracted when their bodies were filled with eggs, which was specially important in the interest of a total destruction. A transportable acetylene apparatus which could be installed immediately in the woods, likewise gave favorable results with experiments made on a smaller scale.

Should the butterfly nuisance not have been eliminated entirely by last year's tests, the same process will be applied on an even larger scale this year in the city of Zittau.

The Universal Song

For it stirs the blood in an old man's heart,
And makes his pulses fly,
To catch the thrill of a happy voice
And the light of a pleasant eye.

—NATHANIEL P. WILLIS.

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REHEARSING A PHILIPPINE WAR SCENE.

PICTURES THAT SPEAK

By P. HARVEY MIDDLETON

THE popularity of moving pictures, which have swept like a tidal wave over the country, from Maine to California and from the Great Lakes to the Gulf, has demonstrated the enormous money-making possibilities of the actorless theatre. Here is an infant industry with twenty-five million American dollars invested in it, boasting a Trust and Independents, a dozen trade papers, and thousands of theatres—as gaudy and glittering as tiles, plaster, gilding, marble, mirrors and wonderful trick electric signs can make them—built especially for its favorites, to say nothing of scores of formerly unprofitable theatres and vaudeville houses now occupied by the ubiquitous projecting machine. And the secret of the meteoric success of this form of entertainment is found in the irresistible attraction for the average person of something that moves. Lamentable as it may seem, an automatic figure whose eyes and mouth open and shut with idiotic regularity will attract far greater attention than the most marvelous mechanism evolved by the human brain if the latter is motionless.

Have you ever been "behind the scenes" of a moving picture theatre? No? Perhaps you never even realized that there was any "behind the scenes,"

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and perhaps you do not know that the highest priced professionals are employed in the performance of these hitherto silent comedies and tragedies. The meaning of that word "hitherto" will appear later.

At one time the public was satisfied with just ordinary moving pictures of interesting events at home and abroad, but nowadays "the play's the thing," and the enterprising moving picture concern

An Entire Opera Company in a Single Box.

must needs employ authors and actors, artists to paint the scenery and settings, and all the paraphernalia of a well equipped theatre. And strenuous things are often asked of the moving picture actor or actress, both in the studio and out of doors.

Last winter the writer was a passenger on one of the New Jersey ferry boats. When in midstream a shabbily dressed young woman suddenly darted to the rail and leaped into the icy water. There was a big commotion for some minutes until the poor creature was fished out in an apparently dying condition by a man in a rowboat. But she was only doing a stunt for a moving picture melodrama, and while the passengers were working themselves up to a fine state of excitement a quiet looking young man on the upper deck was calmly taking pictures of the thrilling scene. A month or so later I saw the whole incident enacted on the screen of a Sixth Avenue Nickelodeon.

The studios of these concerns are hidden away in obscure parts of New York. One of them is in the Bronx, another in the wilds of Brooklyn, and another on Eleventh Avenue. It is to this latter delectable neighborhood, known to the impolite as "Hell's Kitchen," that we will wend our way, for here is the home of the very latest development of motion photography, an invention that is destined to revolutionize the entire industry.

Our destination is near the corner of Forty-Third Street on Eleventh Avenue, a large building bearing the word "Cameraphone" in gilt letters. Here we meet an old friend who is the manager of the new enterprise, and a veritable encyclopaedia of moving picture knowledge. He knows the business from A to Z. We have arrived just in time, for a new reel is about to be exhibited for the benefit of some out of town managers. We take our seats in the tiny theatre and the show commences. First the names of the members of the cast are projected on the screen—for these are no ordinary moving pictures, performed in pantomime by nameless actors.

The opening scene is St. John's Church, Richmond, Virginia, in 1775. with the Virginia Convention of that year in session. George Washington, Thomas Jefferson, Richard Henry Lee, and a score of other notable historical personages are present. The picture reveals them sitting in the pews of the quaint old church. The immortal Patrick Henry steps forward—and right there comes the surprise of your life. You expect the usual silent if eloquent gestures of the moving picture actor, but Patrick Henry opens his month and with impassioned mein delivers in a resonant voice his classic oration "Give Me Liberty or Give Me Death" to pews filled with a band of patriots of deathless fame. As his clear, ringing tones come through the sheet directly back of the moving lips the effect is absolutely human.

The thing awes you with its spook-

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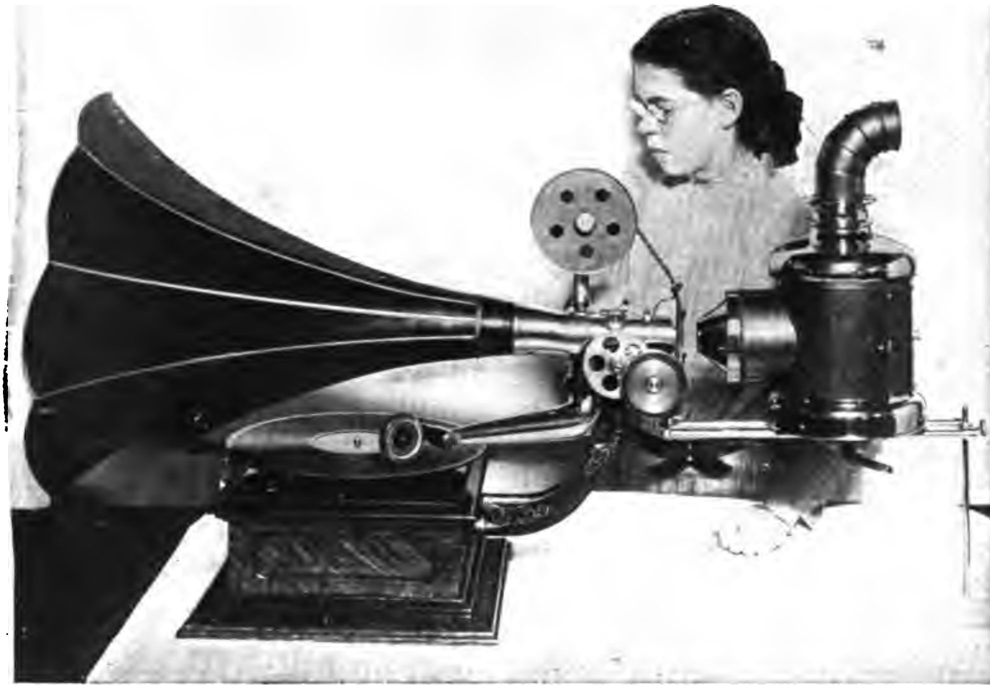

THE PHOTOPHONE IN OPERATION AT A PRIVATE DEMONSTRATION.

iness, and then the tremendous significance of this most important step in the history of motion photography gradually forces itself upon you. You realize that here is an ideal means of preserving the actual personalities of the world's great men and women, an invention that will enable our grandchildren to command the presence of the Roosevelts and Bryans, the Tetrazzinis and Carusos of our own times, and make them talk and sing at will. Compared with the finest efforts of the silent film makers, the new pictures are like living flesh and blood, a talking, breathing personality, compared to a statue.

The historical incident is quickly followed by an up-to-date vaudeville act, and the performance runs right through the usual programme of a first class theatre—the only difference being that the living bodies of the performers are absent. Their disembodied spirits entertain you just as well.

You are, of course, all eagerness to find out how it is done. In the art of motion photography, after exquisite artistic skill has made more and more daring achievements possible, the limit has been reached, so far as the pictures themselves are concerned. Various inventors have perceived the possibilities of combining the phonograph principle with the motion picture, and their inventions have from time to time been dealt with in this magazine. The photophone is one of them; but while it combines in one machine the voices and the picture, there is no actual connection between the two.

It has remained for a young Oregonian, James A. Whitman, after two years of difficult experimental work, to produce the projected image and the sound record in perfect unison—in absolute synchrony. In New York City in a building comprising 50,000 square feet of floor area on six floors, are provided the finest facilities in the world for motion photography and for making the special sound records. Here scenes from plays and operas, song

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LOOKING FROM THE STAGE TO THE CAMERA BOOTH. SHOWING 100,000 CANDLE-POWER LIGHTS.

numbers, dances and speeches, in fact entertainments ranging from modern farce to classic tragedy, are being produced and prepared. A quarter of a million dollars a year is set aside for productions. All the subjects are American, made by American artists, except of course some of the grand opera numbers.

Each week from seventy-five to one hundred actors and actresses are employed. The material is first carefully laid out, and the performers who are to make the voice records study their lines; for the "records" must be made separately from the pictures. If an opera is being produced all the principals and members of the chorus must be vocally drilled. After the orchestra rehearsals are completed we see the assemblage singing the opera into the recording phonograph. From the wax "master record" so produced a copper mold is made electrically, and the wax is molded therein into hundreds of duplicates.

When finished a set of records giving all the sounds for the opera or other act is given to the stage manager, who in one of the three spacious rehearsal halls drills the performers to the accompanying sound of the phonograph rendering the voices and music. Meantime in another part of the building the scenic artists are painting the scenery and the carpenters and property men are busily at work. Then the whole company assembles on the stage, which in this case is the photographic studio. Here in the glare of nearly one hundred thousand candle power light, from Cooper-Hewitt mercury vapor tubes and powerful arc lights to tiny bulbs, the scene is re-enacted in absolute unison with the phonograph, while the whirring motion camera takes the negative.

Then the film goes to its baths in the developing rooms, where big drums on which it is wound revolve in tanks. Then if the negative is perfect it goes to the printing room. It is possible to print as high as three or four hundred positives from one negative before any appreciable sign of wear appears in the negative. Then with their appropriate titles photographed from large lettering the films are put on reels or spools and fitted into the cameraphone. Its special power of

ASSEMBLING CAMERAPHONE PARTS.

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synchronizing with the phonograph records, which are now on the phonographs behind the screen, enables the skillful operator to give the audience the mystifying illusion of a perfectly reproduced human performance.

Enough duplicates of the film are made to supply a rental service covering the entire United States, and the reels are shipped together with the appropriate records for that week's programme. When a manager contracts for the cameraphone service he receives a wooden box about three feet long by two feet wide. In that box is an entire stage performance for one week's entertainment, which is equivalent to an entire theatrical company, scenery, baggage, costumes, orchestra—everything in fact that he could get by hiring a costly New York production except the actual living bodies of the performers. He is also provided with advance press notices for the programme of the week; big lobby photographs of the performers who will appear so mysteriously at the will of the operator, and a supply of special printing, including twelve-sheet, three-sheet and half-sheet posters, the latter differing each week according to the bill of that week. The charge for the entire outfit for the week is $150.

PHOTOGRAPHIC STUDIO SHOWING A RUSTIC SCENE SET.

In addition to its vast possibilities as a means of entertainment, the cameraphone has obvious educational value in teaching any lesson requiring visual graphic demonstration. For instance, the concern has one film entitled "A Lesson in Physical Culture." A well-known athlete steps to the foreground of the picture and delivers a straightforward talk to the audience, telling them in simple language how to develop muscles like his. By suiting the action to the word he shows clearly just what movements and exercises should be practiced to

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RECORDING AN OPERA.

properly develop the four hundred slumbering muscles in the human frame.

The same form of instruction can of course be used by the best authorities in every field of human knowledge and activity. A famous traveler will transport us to foreign climes, and although he is absent in the flesh, his own voice and figure will point out the objects of interest in the moving panorama. The presidential or gubernatorial candidate of the future will actually speak and appear simultaneously in scores of cities on the same night; the eminent divine will preach to hundreds of thousands anywhere from New York to San Francisco, his charm of manner and personality making powerful appeal to his widely scattered congregations.

Among the theatres used for cameraphone entertainments are the Grand Opera House, New York; the Tabor Grand Opera House, Denver; the Holliday Street Theatre, Baltimore; the Auditorium, Chicago; the Colonial Theatre, Richmond; Bijou Theatre, Atlanta; National, Rochester; Lyric, Dayton; Lyric, Mobile; Academy, Norfolk, and scores of others. In Denver nearly twelve thousand persons attended the cameraphone performances in one day. The charge of admission to the best seats for these entertainments is only ten cents. Subsidiary companies are being formed to exploit the invention in South America and Europe.

The ingenious device called the photophone, which also combines the moving picture machine with the talking machine, so that the words and music of a theatrical or other performance can be heard while the movements of the players are reproduced before the eyes, was invented recently by Mr. L. P. Valiquet.

By the aid of this contrivance anybody owning a talking machine can attach a compact little projecting lantern to it, and exhibit moving pictures on a screen to the accompaniment of a lecture or music, the pictures being projected through the horn or megaphone which is attached

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to the machine. The device is a very satisfactory one.

This little instrument is simplicity itself. One just hangs up a sheet, attaches a gas tube or electric light to the lantern, and the merest child can then reel off the films and display the moving pictures in the drawing room. Thus the thousands of owners of talking machines can now have a moving picture attachment at a reasonable cost, and give exhibitions at home or in public. The lantern can be adapted to electric light, acetylene, or any of the systems by which mantels are rendered incandescent. The lenses will project standard films through any of the existing styles of horns, and will display pictures up to twelve by fifteen feet at a distance of thirty feet, or correspondingly smaller pictures at shorter distances. The result obtained is as good as any moving picture show in a high-class theater fitted with expensive apparatus, and the whole arrangement can be packed away in an ordinary suit case, of course excluding the big horn. A company has been formed in Newark for the manufacture of the device.

TO EXTERMINATE THE PRAIRIE DOG

By M. BEVERLEY BUCHANAN

In the State of Texas alone, prairie dogs eat annually enough grass to support 1,562,500 cows. Utterly useless, the little animal is a pest so dreaded that the Forestry Service has undertaken his extermination. Poison is killing him, wherever he now flourishes, and another resource of the farmer is safeguarded.

WHO would think that the prairie dog, the shy and amusing little rodent that we like to watch before the door of his burrow at the "Zoo," would ever become the subject of government intervention or endanger the success of stockraising? Yet such is the fact. Out on the national forests which Uncle Sam is guarding for the use of the public, expert hunters have gone after the prairie dogs with zeal, ingenuity and poison, and have exterminated them in great numbers because some of the choicest bottom lands have had the grazing ruined for stock by the industrious burrowing of the "dogs."

Attempts made last year at poisoning prairie dogs on the national forests on an extensive scale were highly successful and plans are now being made to carry on the work much more widely next year. Stockmen who had suffered heavily from the prairie dog pest were solicitous to have the work taken up, and gladly offered to co-operate with the service in furnishing men and horses to distribute the poison. Formerly the area of available land in proportion to the population was so great that little attention was paid to such pests as prairie dogs and gophers. But in recent years the development of improved methods of farming, including irrigation and artesian water supply, has led ranchmen to push farther and farther westward over the semi-arid plains, until agriculture and stockraising have invaded most of the prairie dog's domain, the land holdings have decreased in size and increased in value, and the depredations of the pests are more keenly felt.

To ascertain what success could be had

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in ridding considerable areas of the pest, a selection was made of parts of the Leadville and Pike national forests, in Colorado, which were badly infested. In order to demonstrate the effectiveness of the work, an area of some 60,000 to 75,000 acres of actual "dogtown" was selected for the test, by the United States Forest Service. From eighty to ninety per cent of the dogs were killed with the first distribution of the poison.

The poison is prepared by coating wheat with a preparation of strychnine, cyanide of potassium, anise oil, and molasses. When a sufficient quantity is ready, the poisoned wheat is carried to the field of operations. There the stockmen gladly supply men and horses and the wheat is given out to the riders and distribution begins.

Each rider carries the wheat in a tin pail supported by a gunny sack slung across his right shoulder and hanging at his left side. His left hand is free for the reins. With his right hand he uses a tablespoon to measure out the poison and drop it near the entrance of the holes. A little practice enables the men to drop the wheat while keeping their horses on a sharp trot. By crossing the town, to and fro, like a man sowing grain, they can cover a large area in a surprisingly short time. It is necessary to go over the ground a second time and by "spotting" the occupied holes the remaining dogs will easily be killed with a very small amount of poison. The average cost per acre for the poisoning material is one and one-half cents.

Prairie dogs are very obnoxious to the stockmen, for they devour much grass and undermine the surface of the ground with their burrows. Where they establish themselves the destruction of the range is only a question of time. While it is hard to say just what amount of feed a prairie dog will consume in the way of grass, it has been estimated by the United States Biological Survey that thirty-two prairie dogs will consume as much grass as one sheep, or 256 dogs as much as one cow.

BRINGING THE POISON MIXTURE TO BOILING SO THAT THE INGREDIENTS WILL BE COMPLETELY DISSOLVED.

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Based upon an average of twenty-five dogs to the acre, which is considered to be a highly conservative estimate of the population of the villages scattered about on the open range, the same authority estimates that in the State of Texas the prairie dogs annually consume as much grass as would be eaten by 1,562,500 cows. There is no doubt that taking a certain area of grazing land upon which the dogs have established themselves, the value of the land is reduced fully fifty per cent by their inroads upon the feed, not only because of what they eat but because they dig up the very roots of the grass and thus leave the ground perfectly bare about their habitations.

When an area is pretty well cleaned off they migrate to a new spot and repeat the same destructive process, with the result that in the course of years entire townships of land are cleaned as bare as a floor of every vestige of grass, and it takes several years of good seasons to restore the old conditions after the dogs are gone.

The damage done by these little pests consists not only in the loss of grass and other crops eaten, or buried under the mounds, but in the accidental drainage of irrigation ditches, and in the danger to stock from stumbling in the holes. Running horses often trip and break their legs, and riders are sometimes injured and even killed. In Stillwater Valley, Montana, an irrigation ditch on a side hill was tapped by a prairie dog burrow and the water came out fifty feet lower down the slope. The hole was twice stopped and the ditch moved a little, but the break recurred and it was finally necessary to dig a new ditch around the washout.

The chief obstacle to the extermination of prairie dogs on the plains is lack of co-operation among landowners. It is of little use to kill off the animals on ranches adjacent to large colonies in which the pests are allowed to go on multiplying. Many ranchmen who have

Pouring the Poison Mixture Over the Wheat.

again and again poisoned those on their own lands have finally given up in despair because of the rapid overflow from adjoining lands, new animals constantly taking the places of those killed, until the expense and labor of repeated poisonings were too great to be continued.

In some states drastic measures have been recommended. In Texas, a bill was introduced in the state legislature making it the duty of every man owning land

SPREADING THE POISON-COVERED WHEAT IN THE SUN TO DRY.

inhabited by prairie dogs to destroy the animals, under penalty of a fine not exceeding $100 for each section or part of a section on which pests were allowed to remain.

The state of Kansas has been carrying

DEAD DOGS HAVE BEEN FOUND WITHIN THIRTY MINUTES AFTER THE POISON WAS PUT OUT.

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on a warfare against the prairie dog for the past two or three years, and the sum of $100,000 was appropriated by the Kansas legislature for the purpose. The work has been so successful that today Kansas is practically free from the pests.

There is little doubt that the poisoned wheat will also promptly kill squirrels, gophers, and field mice, as well as the dogs. Dead skunks and badgers have been found in the prairie dog villages where the poisoned wheat has been scattered, while dead squirrels, chipmunks, and field mice have been noticed close to the villages, which undoubtedly were killed by the poison.

The work of the Forest Service is considered to have demonstrated the entire feasibility of fighting prairie dogs with poison, the action being almost instantaneous. Most of the prairie dogs in a town are dead within an hour after the bait is dropped. It was found, that to be successful the poison must be scattered in the spring, when the dogs first come out from their winter quarters and before the green grass is offered to appease their hungry appetites.

Range improvement in the National Forests is one of the chief objects of regulating the grazing. For this reason the service is leaving no stone unturned to prevent range deterioration. Next year it is proposed to clean up the areas inside the National Forests, and it is believed that when the stockmen see how successful it is, the various states will be induced to take it up on the open ranges and thus sweep these little pests out of existence. The first experiments in this line were made in New Mexico by a stockman who has since entered the Forest Service, and who directed the successful experiments last spring. In 1901 Dr. C. Hart Merriam, chief of the Division of Biological Survey of the Department of Agriculture, made a report upon "The Prairie Dogs of the Great Plains" in which the damage done by the dogs was pointed out, and various methods of poisoning them were suggested. This report of Dr. Merriam's may be said to have practically blazed the way for the highly successful and practical work in prairie dog extermination done by the Forest Service.

THE EFFECT OF THE "DOG MEDICINE" ON A VERY SMALL AREA.

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MAKING BETTER STUFF TO BREATHE

By H. G. HUNTING

A MAN of science in Berlin has taken to running ordinary air through a machine to make better stuff to breathe of it. Not satisfied that the atmosphere which nature furnishes for the purpose is all that it should be, he has undertaken to make of it a more acceptable and useful and valuable human asset. The only queer thing about the matter, too, is that he is accomplishing it.

Everybody knows that oxygen in our air is a good thing. It is possible to get too much of it, like other good things, but there is comparatively little suffering caused among members of the human race, just at this stage of the world's life, by a superabundance of this particular desirable. In fact, sometimes it seems as if many of us were trying to see how little of it we can assimilate, without actual asphyxiation, instead of enjoying a full measure as one of the luxuries of existence. But it isn't always our own fault, it seems, and that's why the Berliner, Dr. Fischer by name, a member of the faculty of the famous Berlin University, has produced his invention.

It is no news to the world that the oxygen in our air is capable of being changed into a thing called ozone, a mighty enemy of bacteria and other things inimical to human lungs and human blood, destroyer of bad smells and powerful purifier in general. Sunlight itself, by constantly producing the stuff in dilute form, disinfects daily and hourly, to a degree, the air we breathe. The trouble is that we have too little sun, because of our smoke and our dust and our roofs, under which we stay too large a portion of the time when the ozone-producer is working.

OZONE FAN CONSTRUCTED BY DR. FISCHER.
This fan concentrates the ozone in the atmosphere.

The disinfecting properties of ozone, which have been well known for a long time, have recently been applied to the purification of drinking water, and this seems to have suggested to Dr. Fischer the idea of producing the agent artificially for the purpose of purifying air as well. The cost of such production was low enough to justify the experiment and the results have been gratifying. The ozone ventilator he has invented produces the active gas by means of the employment of high temperature. He has found that certain chemical reactions take place in the air under tremendous heat and has recognized that ozone is one of the products. His apparatus, therefore, includes a Nernst filament, which owing to the high temperature it is capable of enduring—2,000° C—lends itself to the purpose, most admirably. The percentage of ozone produced depends largely on the degree of the heating and the rapidity of cooling the air which passes through his appliance. Under ordinary conditions surrounding a Nernst lamp, the highly heated atmosphere cools so slowly that the ozone produced decomposes again into ordinary oxygen. The purpose of the inventor then was to cool his hot air quickly enough to keep the percentage of ozone in it as high as possible, thus making it serve its purifying purpose before it returns to its original state.

ISOLATED OZONE FAN CAN BE PLACED WHEREVER SPACE BEST PERMITS.

Dr. Fischer's ventilator draws the air-current at a suitable velocity over the heated filament, raising it to a very high temperature. Immediately after heating, the current is then plunged directly into cold air again and the sudden drop of temperature causes the change which makes the ozone available. The apparatus comprises a small ventilator, designed to exert a suction effect. The fan is placed inside a funnel, provided with the Nernst filament, which is adjustable and readily changeable. The filament is an electric conductor of the second order and conducts electric current only after being raised to a certain degree by means of a heating coil. When the ventilator is started, therefore, the heating coil

PORTABLE OZONE FAN.
This fan can be moved about a room or changed from one apartment to another.

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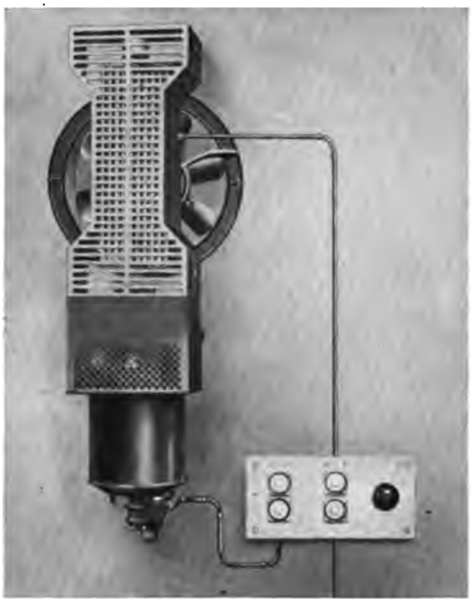
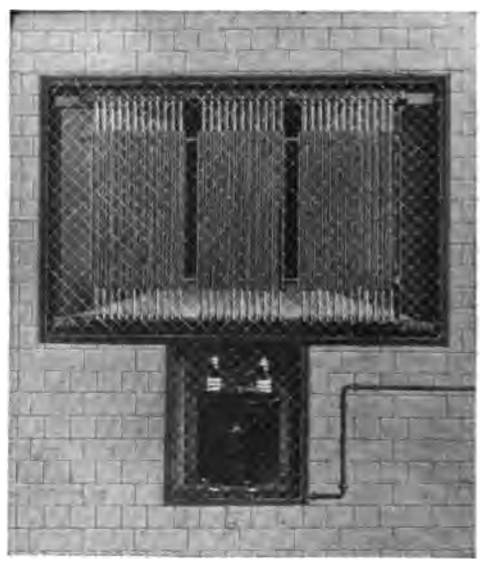


OZONE WALL FAN.
An effective form for limited use.

receives the first current. At the moment when the filament becomes conductive and therefore ready for business an electro-magnet inserts the fan-motor and disconnects the heating outfit. A lamp, arranged in series, serves as additional resistance.

A drawback to such use of ozone as is contemplated, when the uses of this new apparatus are considered, lies in the fact that, though the gas is very highly effective in the destruction of bacteria and other impurities in the air, it also has, in such concentrated form, a damaging influence upon the mucous membranes. If the air is excessively ozonized it becomes too many for the flying agents of disease, but it also is decidedly harmful to the human body. A percentage of the oxygen only therefore can be safely turned into ozone for the use of the lungs and the amount has been fixed at one-tenth of one per cent. With this amount, all the valuable purposes are accomplished and no deleterious effects appear. The machine of Dr. Fischer converts just so much of the oxygen into the more active gas and no greater amount, no matter how long it is operated. When, in a room in which it is at work, the atmosphere is brought to a condition where it contains the proper percentage of the ozone, the machine destroys an amount equivalent to the amount produced, so that the average is kept constant. No harmful effects can follow and, as the ozone is used up by busy lungs and performs its task of microbe killing, it is constantly replaced by the apparatus. The result is an ideal ventilator. A large room requires but a few minutes to fill with its proper percentage of the gas, the smell of which is characteristic and easily detected.

Another ozone fan, based on the power of electric discharges to accomplish similar results, is constructed by a German firm. It is more like the ozonizer for the purification of water than like Dr. Fischer's machine. The fan which draws the air into the ventilator is fitted with an iron framework of alternating metal rods and plates. The rods are surrounded with glass for the purpose of insulation and each pair of rods and plates forms a pair of electrodes inserted in a high tension circuit of an alternate current transformer, one terminal of which for safety's sake is connected with the ground. During the operation of the machine, a dark bluish discharge or glow



AIR-OZONIZER FITTED INTO VENTILATING PIT.

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is produced between the plates and the glass covered rods, as the only optical manifestation of what is taking place. The air passing through the framework of the ventilator, however, under influence of the high current, is ozonized, enters the room to be ventilated, and acts as a purifier, exactly as it does in the other instance.

OZONE FAN IN WORKMEN'S DINING HALL.
It is this sort of use that best demonstrates its value.

Incidental to the operation of these ventilators for the purpose of microbe-killing, the additional advantage of a good distribution of the purified air results. The expense, too, is low for, the apparatus ozonizing from 35,000 to 175,000 cubic feet of air per hour, needs but thirty to 150 watts to operate.

When very large spaces, like whole buildings of large size are to be ventilated by the process, ventilators delivering more concentrated ozone may be employed to advantage. The ozone is then produced at a central plant outside of the building and is afterwards mixed with the air and thrown, by means of a compressor, first into air-pits and then through a system of conduits, to the room to be aerated.

In any room where the air is likely to become vitiated through much breathing, this form of ventilator is a blessing indeed. In buildings of all sorts for public use, schools, halls, theaters, churches, which are notoriously difficult to ventilate properly, even with elaborate systems of fans, this ventilator has a work to perform. In many kinds of workshops, where the nature of the business is such that ordinary ventilation is objectionable, the ozone-machine can fill a much felt want. In the tunnels of the subways, in which some of us must necessarily spend a part of most of our days, such ventilation will give escape from great discomfort and considerable danger. On shipboard, passengers from cabin to steerage will benefit by its use and it may even be applied to the support of livable conditions in submarines, to supplement apparatus now in use.

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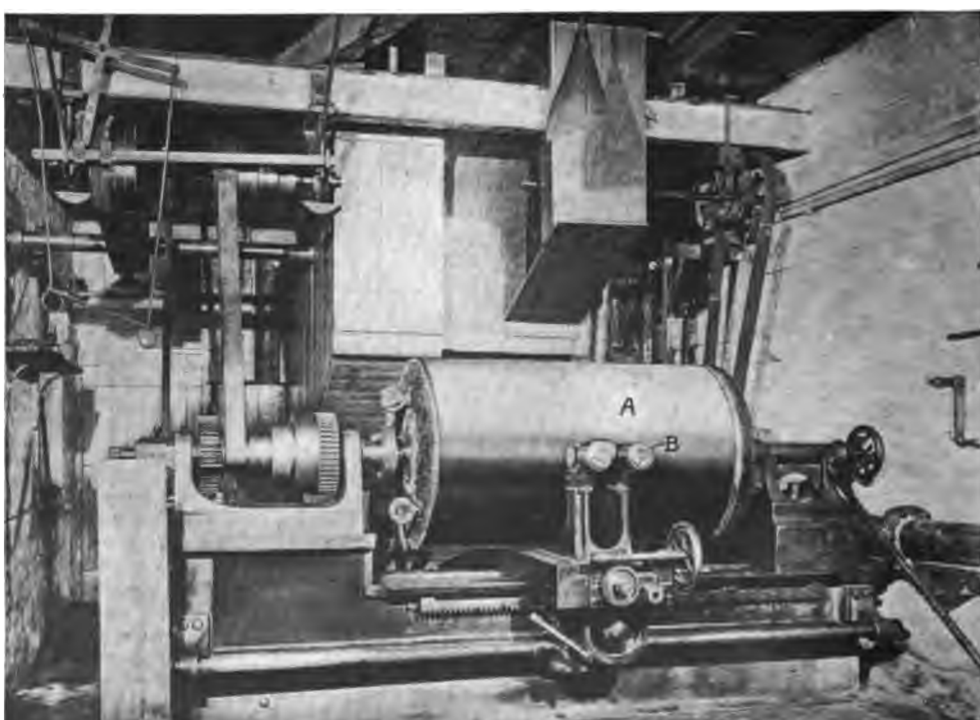
COPPER SHEETS AND WIRE DIRECT FROM RAW ORE

By F. A. TALBOT

ENGLISH CORRESPONDENT TECHNICAL WORLD MAGAZINE.

AN extraordinary development in the copper manufacturing industry which promises to become of far reaching importance has recently been evolved, whereby it is possible to produce wire and sheets of varying diameters, thicknesses and widths in continuous lengths in one direct operation from the crude metal. Moreover not only is the new process cheaper, quicker, and cleaner than the existing methods in vogue, but the resultant article is of far greater strength than that produced in the ordinary way by rolling, swaging, or drawing.

This process is the invention of an eminent British electro-metallurgist, Mr. Sherard Cowper-Coles, and its widespread importance may be gathered from the fact that a German firm has acquired the invention and is at the present moment completing the construction of a large factory where the process will be



SPECIAL PLANT FOR EXPANDING AND REMOVING A LARGE COPPER CYLINDER FROM THE HIGHLY POLISHED DRUM.

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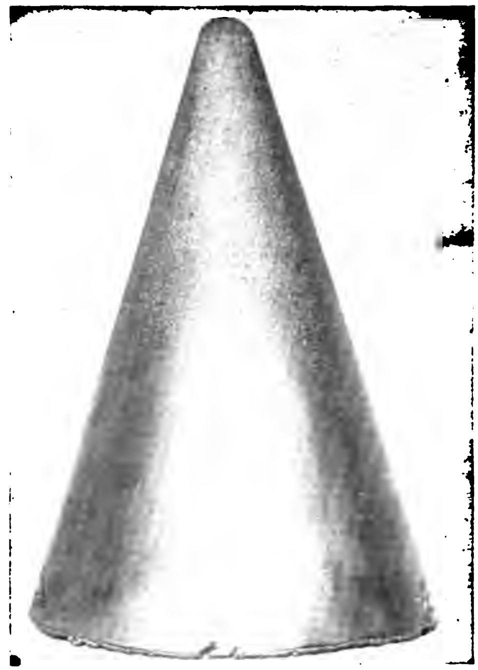
exploited upon an extensive scale. In view of the fact that the Teutons are among our keenest rivals in the manufacture of copper articles, especially for the electrical industry, and will now be in a position to supply not only a purer article but at a lower price, such a development cannot fail to exercise an important influence upon the products of our native factories, especially in the foreign markets.

The process is said to be entirely new. The copper is deposited by electrical agency upon the surface of a drum or cylinder driven at a predetermined speed while immersed in a vat or huge cell. The theory of the process is that each molecule of copper as deposited upon this cylindrical surface is burnished or rubbed by the friction of the solvent solution or electrolyte in the cell, so that a perfectly pure and homogeneous metal is obtained. The wire or sheeting thus secured is far denser, tougher, and of better texture than that possible under the application of the greatest pressure or drawing as is now practised.



THE CONE UPON WHICH THE EXPERIMENTS WERE CONDUCTED.

Another salient point that must be borne in mind also is the fact that by the Cowper-Coles method it is possible to use a very impure copper, as well as a very impure electrolyte. That is to say, a solution in which there is a considerable amount of deleterious matter in suspension. These impurities are not deposited upon the cylinder, but are thrown off by the centrifugal force caused by the rapid revolution of the cylinder within the vat, combined with the rubbing action caused by the friction of the solution itself upon the particles of copper as deposited upon the cylinder. Consequently the wire or sheeting thus produced is composed of only the pure copper. This is a factor of very great significance, as by existing methods of electro-deposition it is essential that the copper be subjected to a prolonged and thorough course of refining before being used. Again, the consumption of electrical energy in the latest process is much less, so that the production of a pure metal is obtained at a trifling cost.

MICROPHOTOGRAPH OF DEPOSITED COPPER, SHOWING CRYSTALLINE STRUCTURE.

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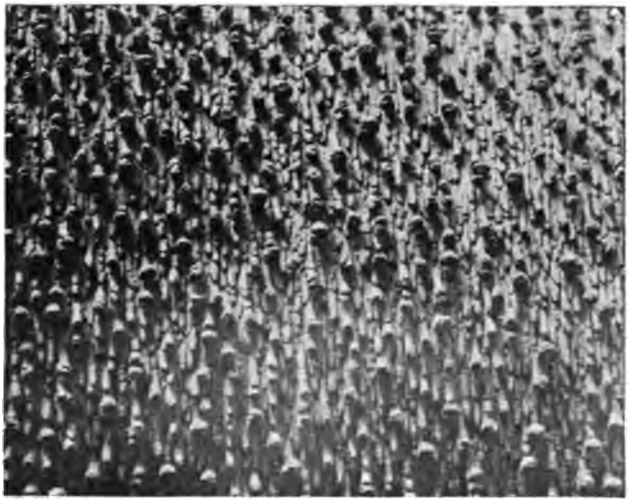

MICROPHOTOGRAPH OF THE COPPER NEAR THE APEX OF THE CONE, SHOWING ITS RAGGED APPEARANCE DUE TO INSUFFICIENT SPEED OF ROTATION.

photographs plainly reveal individual knots or protruding balls of copper at the apex, giving place gradually to irregular streaks and finally to a smooth surface.

Particles of copper electro-deposited in this manner crystallize at right angles to the surface upon which they are deposited. This fact has been turned to peculiar advantage in this process, since the cylinder upon which the metal is to be deposited is inscribed from end to end with a continuous spiral scratch, the channel being V-shaped. The result is, that when the cylinder receives its desired covering of the metal from end to end the line of demarcation corresponding to the scratch is readily observable and affords a ready means of breaking the copper at that point. Consequently by revolving the cylinder in the direction opposite to the travel of the scratch, the metal is uncoiled in a strip of uniform thickness readily breaking along the

THE COPPER BECOMES SMOOTHER AS THE BASE OF THE CONE IS APPROACHED.

As already mentioned the secret of the process lies in the speed at which the drum is revolved when in the vat. If the speed is too slow the surface of the copper is very rough and rugged, is uneven in thickness and consequently lacks strength. On the other hand, when the cylinder is rotated at the correct or critical speed the surface is perfectly smooth as if it had been planed down or burnished, the appearance resembling that of polished marble. In order to determine precisely at what speed the cylinder should be revolved the inventor carried out a series of interesting and ingenious experiments with a cone. This was slung longitudinally between two bearings and then rotated. Near the apex where the speed was slowest the copper, upon deposition, assumed a very rough and uneven surface, but as the cone was gradually traversed towards its base and widest end where the speed was greatest it became smoother and smoother until finally it was as smooth and symmetrical as a plate glass mirror. The results of these experiments may be plainly followed in the accompanying illustration of this cone and the effect of the varying rotating speed upon the electro-deposition of the copper particles. The peculiar effect incidental to insufficient revolving speed is even more strikingly shown by microscopic investigation as the micro-

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edge of the V-shaped channel. It is essential, however, that this spiral scratch be of V-shape, since if it be of U-form no line of cleavage is formed and the copper will not come off the cylinder in a continuous strip.

The plant by means of which the process is carried out is of very simple design and construction. The cylinder with its spiral scratch is mounted on a shaft which is immersed in an annular vat or cell containing the acid solution or electrolyte. The lower end of this shaft carries the positive connection of the electric circuit, the negative pole consisting of crude copper extending down one side of the vat. The arrangement, it will be observed, ensures no working parts being immersed in the acid electrolyte, while the cylinder or mandrel can be easily and quickly withdrawn as desired. The mandrel is revolved at the requisite speed by means of either gearing or belting. With such a vat it is capable of handling a mandrel which can produce a strip of wire from three to five miles in length. Deposition completed, the mandrel is swung in a lathe and rotated in the opposite direction, the copper deposit readily unwinding in the form of the wire. It is then passed through a set of dies to remove the burr or fin, due to the edges of the spiral channel, and formed into round section.

Following up the success of this idea the inventor applied it to the production of copper cylinders or sheeting. Such cylinders of large diameter are in great request for printing purposes in connection with the textile industries and a smooth surface combined with a high degree of metallic purity is required. For such requisition the Cowper-Coles method is pre-eminently adapted, and, similarly, production is expeditious and cheap: Fundamentally the process is the same as that followed in the manufacture of wire. A drum of a diameter corresponding with the internal dimensions of the de-

PLANT FOR THE PRODUCTION OF LARGE COPPER CYLINDERS AND SHEETS BY THE NEW ELECTRICAL PROCESS.
C is a highly polished drum which is lowered into the vat and upon which the copper is deposited. *D* is a continuous sheet of copper made by this process.

sired cylinder and having a highly polished surface is mounted upon a vertical shaft and lowered into the vat or cell containing the electrolyte. The cap of the vat is then screwed into position and the electrical connections completed. The mandrel or cylinder constitutes the positive pole and this is rotated by belting and pully at the requisite speed. A mercury cup is placed on the top of the driving spindle, electrical connection being made with the arm B, shown in the illustration, which fits on to the top

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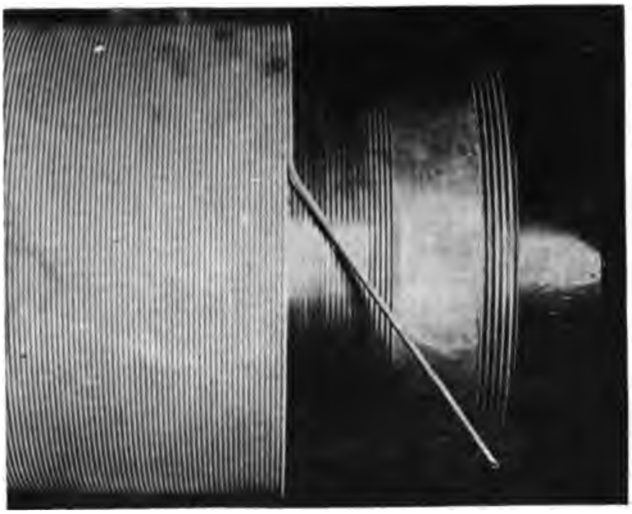
bracket. The negative poles comprise bars of crude copper just as cast, and these are joined to the electrical circuit by the conductors A. If it is desired to produce a continuous sheet of copper instead of a cylinder, a strip of insulating material is carried down one side of the mandrel from end to end. Naturally a cylinder produced by this process though not adhering to the polished surface of the mandrel fits so tightly that it cannot be moved, and in order to enable the core to be withdrawn a special apparatus has been evolved. This resembles a lathe, the mandrel being slung between centers. A roller is then brought against the outer surface of the copper and the machine set in motion, this roller traveling from one end to the other of the mandrel. Owing to the pressure thus exerted the copper sheathing of the mandrel is slightly stretched, so that the cylinder can then be easily slipped off from its mandrel. The copper of the cylinder itself is about one-thirty-second of an inch in thickness, but its outer surface is as smooth and polished as plate glass, of great strength, and forms an ideal cylinder for printing purposes.



Unwinding Copper Strip for Wire After Deposition Upon the Cylinder, Showing the Spiral Scratch on the Mandrel.

The copper produced by this method is to all intents and purposes absolutely pure, analyses having shown that, notwithstanding the impure nature of the copper used and the extent of foreign substances present in the electrolyte, the finished article only contains about 0.03 per cent of impurities. The copper is as hard as that obtained by cold rolling, and possesses remarkable strength. Tubes produced by this method and without any additional drawing have been found to withstand a strain of seventeen tons, and to withstand a pressure, after drawing, of 3,000 pounds per square inch, the thickness of the metal being only 0.063-inch, while sheets without rolling have given a maximum stress of from 28 to 34 tons per square inch. The plant required for the process is simple and free from mechanical complication; the method is at least ten times faster than any existing system of electro-deposition.

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BALLOON WITH AUTOMOBILE FOR BASKET.

CURIOUS AUTOMOBILE FEATURES

By WILLIAM WALSH

AUTOMOBILING in a balloon sounds absurd on the face of it, yet the other day in Indianapolis two men made an ascent with a motor car attached. These men were G. L. Bumbaugh, a professional aeronaut of Springfield, Illinois, and an Indianapolis automobile dealer.

Procuring a balloon with a capacity of 100,000 feet of coal gas Bumbaugh and his companion replaced the ordinary basket of the balloon with an automobile. The big bag was filled, the machine stripped of the tonneau, lights and all other superfluous weight, and sand ballast was taken aboard in sacks distributed evenly about the machine and balloon. Then the automobile was fastened securely to the load ring under the balloon

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THE BODY OF THE AUTOMOBILE TO WHICH THE GYROSCOPE HAS BEEN APPLIED.

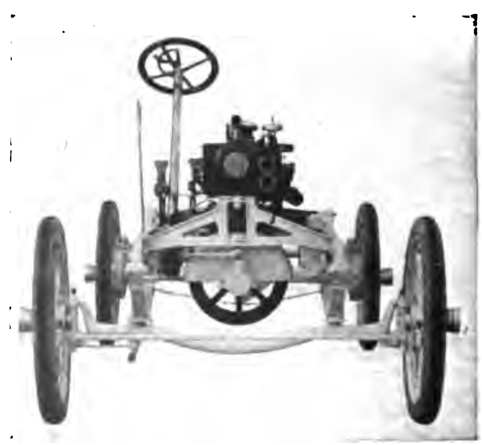
and when the bag was released rose quickly and evenly from the ground, carrying the two daring experimenters in the car.

This ascent was not undertaken merely as a freak, but for a very practical end. Its purpose was to demonstrate the feasibility of carrying, on long distance flying trips, an automobile, in which after the descent, the aeronauts could return to their starting point. But not only is the automobile being put to unusual uses; there is novelty, too, in the types constructed. Thus J. P. Lavigne, a Detroit inventor, has recently come forth with a new principle as applied to automobiles; namely, the gyroscope. The important achievements of this invention are steadier running, and lessening of the danger of overturning.

In principle of construction the car is a radical departure from that of any machine heretofore manufactured. By means of the gyroscope, it will be recalled, a monorail car traveled along a single wire suspended in the air in a demonstration made before the Royal Society of London more than a year ago.

It is this principle which inventor Lavigne has used in the gyroscope automobile. He has utilized the familiar flywheel which is found in nearly all gasoline motors, but the departure consists in placing the flywheel in a horizontal instead of a vertical plane, a device which monopolizes all advantages with fewest disadvantages.

The fundamental of the gyroscope is the resistance presented by a revolving disc or wheel to any change of direction in the axis of its rotation, that is, any change which tends to remove it from its normal plane. Thus, gyroscopic action causes a disc or wheel to place its axis at right angles to the plane into which the axis is moved, a phenomenon which becomes easy of notice if one tries



THE FLYWHEEL OF THE GASOLINE MOTOR IS PLACED IN A HORIZONTAL INSTEAD OF VERTICAL PLANE.

to move a revolving bicycle wheel from a horizontal to a vertical position while supporting it by the axle ends.

In the gyroscope automobile, the exercise of this action tends to maintain the chassis of the car in which the fly-

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FORTY-HORSE-POWER PROPELLED CHEMICAL ENGINE.

wheel is suspended horizontally and which thus becomes the normal plane of the gyroscope, always parallel to the ground over which the car is moving, so that the higher one side of the car is raised above the other, either by foreign agents, such as bumps or stones in the road, or by the centrifugal force exerted on the car by the turning of a corner, the more power is exerted by the gyroscopic arrangement toward maintaining the original relation of the car to the level on which it is traveling.

There is a curious type of car fitly termed the "flying automobile," which is, in reality, not an automobile at all, but a form of air-ship. A Mr. F. Heinz of Sarajewo, Austria, is the inventor. It is based on the principle of the so-called kite-flyers.

Now in the case of the kite-flyers, the resistance due to the propulsion of the machine is utilized in supporting the flying-machine. The supporting kite-surfaces are, however, of excessive size in proportion to the surface of the propelling screw. The latter accordingly has to rotate at a very high speed, in fact, at a far greater speed than corresponds to the wing motion of large birds.

The utilization of the air resistance resulting from the propulsion of these flying machines accordingly is far from being as rational as in the case of birds, in which the propelling screw surfaces and the supporting kite surfaces—that is the wings — are of identical size, performing a rather slow motion.

In the flying propeller designed by F. Heinz, the kite position of the wings during the half circle of rotation of their upwards motion already results from the oblique position of the propeller shaft.

Owing to this kite position of the wings, the air resistance resulting from propulsion accordingly produces both the rotation and lifting of the flying propeller.

In order to cause the wing during the half circle of rotation of its downward motion to pass through the same angles —though not in the kite position, but in propeller position—it is attached by means of hinges to a rigid frame, fixed to the propeller screw in the same way as window sashes are fitted to the window frame. It is thus able to assume in this frame the required angular position, corresponding to a screw surface. The angular play of the wing inside its frame

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SPECIAL MOTOR CAR FOR THE USE OF CHIEF OF FIRE DEPARTMENT AND HIS ASSISTANTS AT WASHINGTON.

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should be at least 15 degrees in the case of a rising angle of the propeller shaft amounting to 15 degrees.

Accurate calculations show that the consumption of energy in the case of this

THE FLYING AUTOMOBILE.
This is really not an automobile, but a flying machine.

machine is even smaller than the consumption of energy of an ordinary road automobile of the same weight.

In no community have the self-propelled vehicles entirely supplanted horses as yet, but there are today in successful use in various cities in the United States more than half a dozen general classes of municipal automobiles, including fire-fighting apparatus, street sprinklers, street sweepers, road rollers, police patrol wagons, dog catcher's wagons, covered refuse wagons, dust carts and specially designed runabouts and touring cars for the use of officials of the street and health departments and other municipal officers whose duties require them to traverse considerable distances daily.

The automobile water and chemical fire engines and hose carts are gradually coming in. All the standard forms of power generation—gasoline, steam and electricity—are utilized for the propulsion of one or another of the types of American-built fire-fighting automobiles, and each form of energy has its enthusiastic advocates.

The pioneer in the field of self-propelled fire apparatus was the automobile fire engine.

In Boston the adoption of motors has made it possible to introduce heavier apparatus than could have been available had dependence to be placed on horses, and thus Boston has had the advantage of equipment throwing exceptionally powerful streams of water.

Supplementing the automobile fire engines and following soon after from the hands of the manufacturers came automobile hose wagons. Then came a distinct novelty in the form of a searchlight truck, carrying a powerful battery of searchlights—similar to those in use on warships—the function of which is to illuminate dark localities in which the firemen must work.

Several different designs of automobile chemical engines have been evolved by different inventors, but they are similar in the main essentials. Some of the models are not greatly different in appearance from an ordinary touring car, while others have oblong bodies somewhat suggestive of a motor delivery wagon. The indispensable adjunct, present in each instance, consists of two large tanks charged with fire-extinguishing chemicals and attached to which are several hundred feet of hose. Included in the equipment of the motor car are hand grenades, tarpaulins, pikes, axes, scaling ladders and other paraphernalia needed for combating flames according to approved modern practice. The average automobile chemical engine when fully manned will carry at least half a dozen firemen and some of the models have running boards where ten or a dozen men may stand if need be.

Representative of the class of automobile chemical engines in general is a car recently constructed for use in a New England city. It consists of a four-cylinder, 40-horse-power automobile carrying two 30-gallon tanks and 200 feet of 1¾-inch hose. The machine has a speed of forty miles per hour; is equipped with storage batteries and magnetos and has capacity for carrying twenty gallons of gasoline. Its promptness in reaching fires is its strong feature.

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RAISING A WRECKED WAR CRUISER

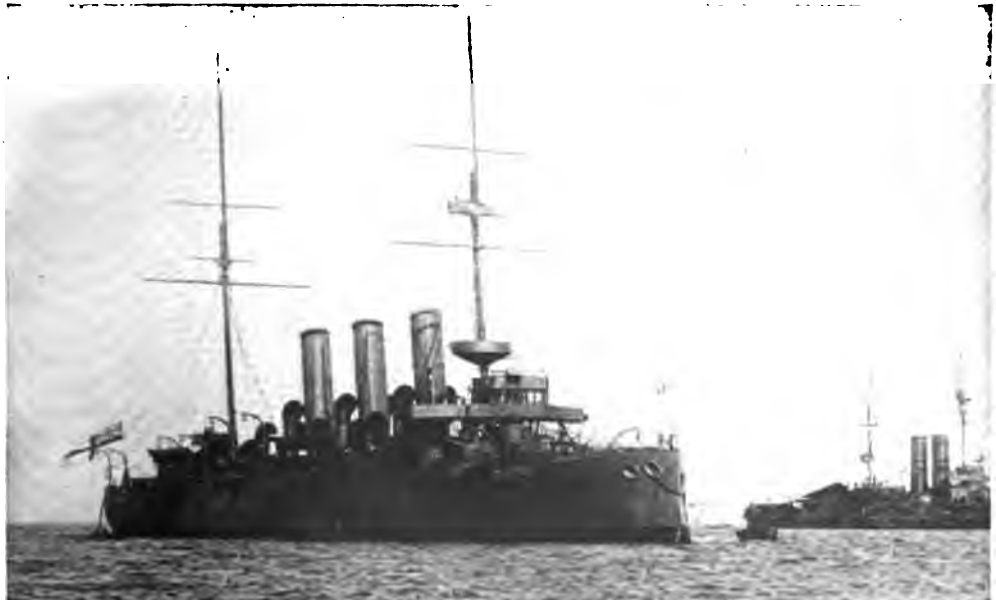
By J. HARTLEY KNIGHT

LONDON CORRESPONDENT TECHNICAL WORLD MAGAZINE.

WHAT in England is generally regarded as the most marvelous salvage feat on record has recently been accomplished in connection with the raising of the cruiser *Gladiator,* which, it will be remembered, was rammed by the American liner *St. Paul* during a blinding snowstorm and became a total wreck off Yarmouth, a little town on the north shore of the Isle of Wight in the south of England. The disaster occurred on the twenty-fifth of April last and the intervening months have been spent in the endeavor to raise the sunken cruiser, the greater portion of which has lain submerged at an angle of 72½ degrees.

The difficult task was entrusted to Captain Young of the Liverpool Salvage Association, who would appear to have taken to heart the moral contained in the well-known story of Robert Bruce and the spider since what might well have daunted another man only helped to spur him on to greater effort. After many abortive attempts the wrecked warship was successfully raised in the presence of many keen experts who followed the operations with the closest interest.

Something like 200 tons of ballast were placed on the *Gladiator's* port bilge keel to assist in the work of restoring her to the perpendicular, and five tugs hauled on hawsers fastened to the masts and passing over huge tripods fixed to the cruiser's side to pull her over. For many hours gunboats un-



THE BRITISH WARSHIP *GLADIATOR,* RAMMED AND SUNK BY THE AMERICAN VESSEL ST. PAUL DURING A SNOWSTORM OFF YARMOUTH, ENGLAND.

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BEGINNING SALVAGE OPERATIONS.

ceasingly pumped out water from the ship at something like 3,000 tons per hour, and, aided by five big air cylinders on either side of the vessel—used to prevent the ship keeling over too far to port when raised—and assisted by her own lifting power the great hull of the *Gladiator* was slowly but surely raised

RAISED ON HER SIDE.

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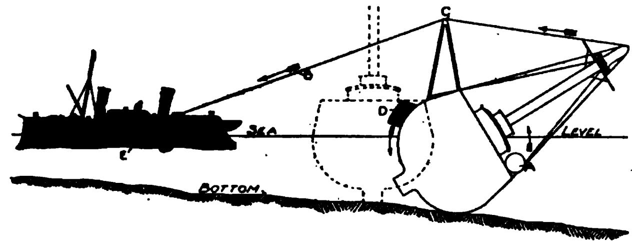

DIAGRAM ILLUSTRATING THE FORCES EMPLOYED TO RAISE THE *Gladiator.*
A—Air cylinder. *B*—Wire hawser. *C*—Salvage tug. *D*—Bilge keel with 200 tons of ballast. *E*—Tripod.

until the vessel once more assumed an unright position.

During these operations powerful tugs were hauling the vessel's bow shorewards, the idea being to right her in more shallow water. In the last attempt in September the workmen labored unceasingly for nearly two days, pumping and hauling, proceeding without a break. At length the *Gladiator* was got on an even keel, with her deck dry and little probability of experiencing any great difficulty in the final operations. It was found that the cruiser's mainmast was considerably bent as the result of the great strain. She was successfully towed to Portsmouth.

NEW FORMS OF FIRE-FIGHTERS

By EMMETT CAMPBELL HALL

ONE of the most interesting devices recently developed is an English petrol motor fire pump. It is of unique construction, and would seem to solve the problem which for some time has bothered fire engineers, viz., whether it is possible to get as good results from a petrol motor pumping engine as from a steam pumping engine, whether electrically, steam, or petrol propelled. The Dennis turbine motor fire engine has proved itself, in severe competition, more capable than any steam pump of the same rated capacity.

The main feature of the machine is, of course, the pump. This is of the centrifugal high pressure, or turbine type with a single casing but which does the same work as others having two casings, yet weighing but half as much. The pump is capable of discharging 350 to 450 gallons of water per minute at a pressure sufficient to throw two seven-eighths inch or one-inch jets 120 feet high. There are no valves in the pump to give trouble, and muddy water and sand may be pumped as easily as clear water. The pressure in the delivery hose is always steady; there is no jerking or liability of bursting the hose. As soon as the pump is started, water is sprayed under pressure into the small tank in the rear of the pump. As the water passes the orifice of the ejector pipe it draws out the air and creates a vacuum in the suction pipe. In the tests eighteen seconds amply sufficed to obtain a full delivery with twenty feet of suction hose. The delivery was tested with two jets, one and one-eighth and one and three-fourths inches respectively, one hundred feet high, and the capacity of the pump for forcing water uphill was demonstrated at Bradford, England, where the delivery hose was taken up the water tower one hundred feet, but even then the jets easily rose fifty feet.

An important advantage of the use of this type of pump is that the pressure of hydrant water may be utilized to the full extent. By connecting the water main direct to the suction of the pump, the pressure of the pump is added to that from the main. Ordinarily the pressure in the mains has to be wasted.

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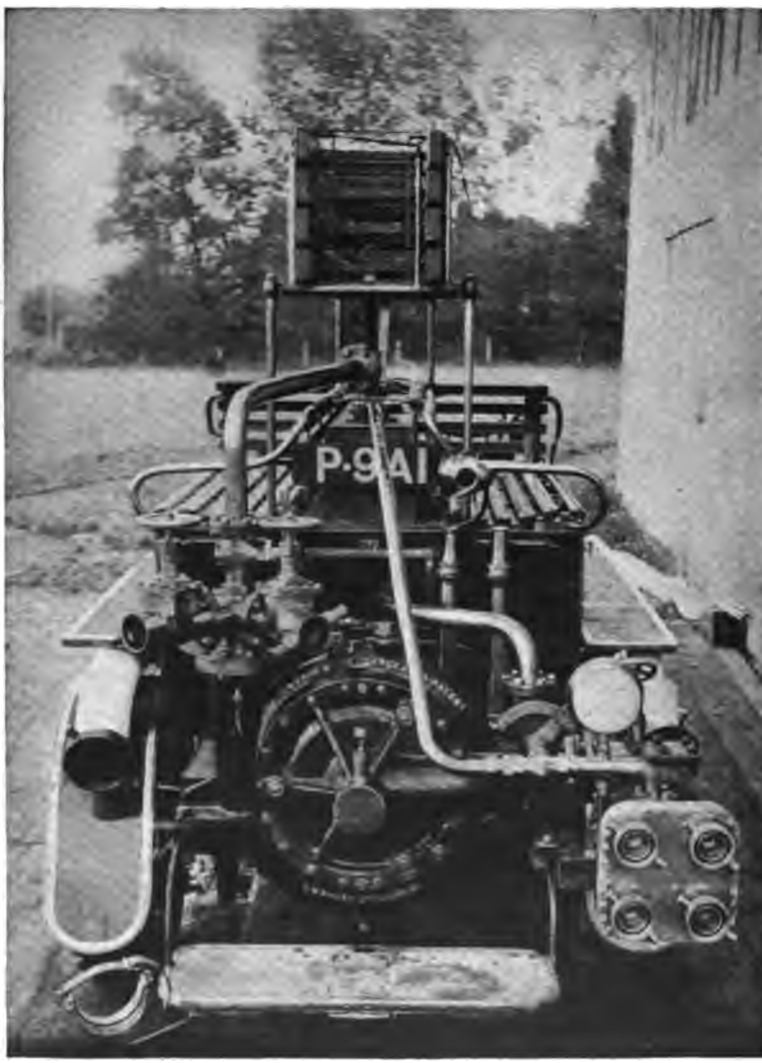
The pump nominally runs up to 1,700 revolutions per minute, but with the addition of another gear the speed can be increased to 3,000 revolutions per minute, and the fullest advantage taken of high pressure hydrants. The absence of reciprocating parts and vibration renders the system fifty per cent cheaper to use than any reciprocating pump.

Provision is made for the carrying of an adequate supply of suction hose, and 400 feet of delivery hose, besides fire engine tools and axes. There are seats for four men on each side, and for the driver and chief in front. The petrol tank is situated under the driver's seat, and is of twenty gallons capacity. A truss telescopic fire ladder twenty feet long when closed and which may be extended to thirty-six feet is carried by the engine, as is also a copper first-aid tank of fifty gallons capacity, with twenty foot air bottle charged with oxygen. A hose reel may be fitted so that the hose may be run off at either end.

The weight of the Dennis fire en-



REAR VIEW OF DENNIS TURBINE MOTOR FIRE ENGINE, SHOWING PUMP, OPERATED BY PETROL.

This pump has a greater power than any steam pump of the same rated capacity.

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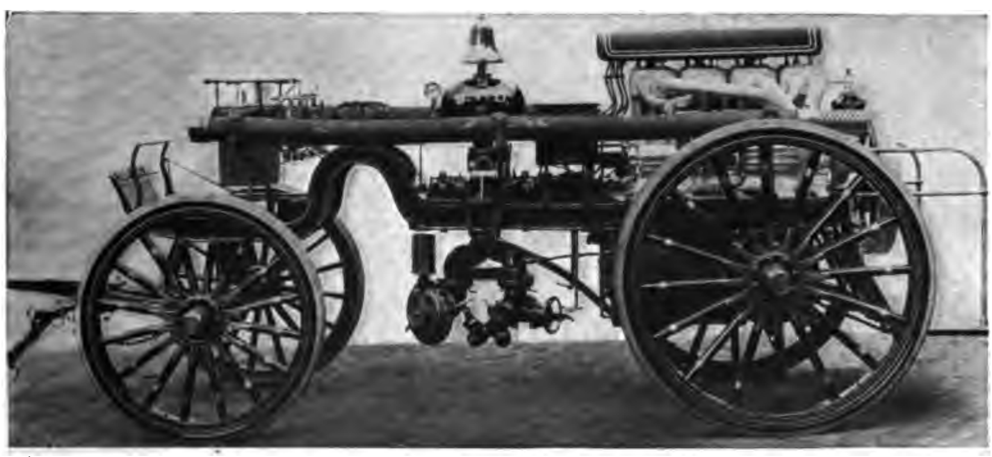
gine, complete with all accessories and ready for the road is two tons, five hundredweight. The petrol consumption is one-eighth gallon to the mile.

It would appear that an engine of this description would be particularly desirable in small towns, or in neighborhoods where there are several towns and villages within a radius of five or ten miles, as the absence of horse-maintenance eliminates a considerable factor where engines are not in frequent demand; the rapidity with which it could respond to an alarm from a considerable distance, moving at a speed of anywhere up to forty miles an hour, and the fact that it can transport a crew sufficient in number to do effective service, are all points to be considered, aside from the comparatively low original cost, when contrasted with the cost of a standard type of steam engine and horses. The cost of this motor fire engine is from $3,850 for a 260 gallon a minute capacity pump to $4,625 for one of 450 gallons per minute.

The city of Brockton, the great shoe town of Massachusetts, has just installed another novel form of fire engine, the engine being operated by using gasoline as a fuel.

The principal points claimed for this style of engine are, first, its cheapness of maintenance, as it requires but a two- instead of a three-horse hitch, and one engineer, instead of engineman and stoker, to run it. Another advantage is, that on a short run, water is pumped through the hose immediately the engine is started, and there is no waiting for water to heat and steam to make, as is the case with the conventional type of engine. It is further claimed that the engine will perform duty closer to its capacity of water delivery than the steam fire engine and that it delivers a more powerful and direct stream unaffected by the vacillation of steam-gauge pressure.

The Brockton gasoline engine is a forty horse-power four-cylinder. It will lift and deliver water from the hose within ten seconds from the time of starting and there is no delay in getting a stream on a fire as soon as the hose is attached to the hydrant and the hose lines are laid. Three lines can be laid from this machine. Its capacity is 600 gallons a minute. The weight is 5,400 pounds, or about two thirds that of a steam engine. The gasoline tank is located beneath the rear of the machine and holds a supply for a day's run. Its cost is $3,800, whereas the usual cost of a steam machine would be in the neighborhood of $5,500.



THE BROCKTON GASOLINE FIRE ENGINE.
A light and very efficient fire-fighter.

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THE "FLIP-FLAP," THE SENSATION OF THE ANGLO-FRENCH EXHIBITION, LONDON. SAID TO BE THE MOST COSTLY SINGLE AMUSEMENT PIECE EVER DEVISED.
The cost of construction was $750,000.

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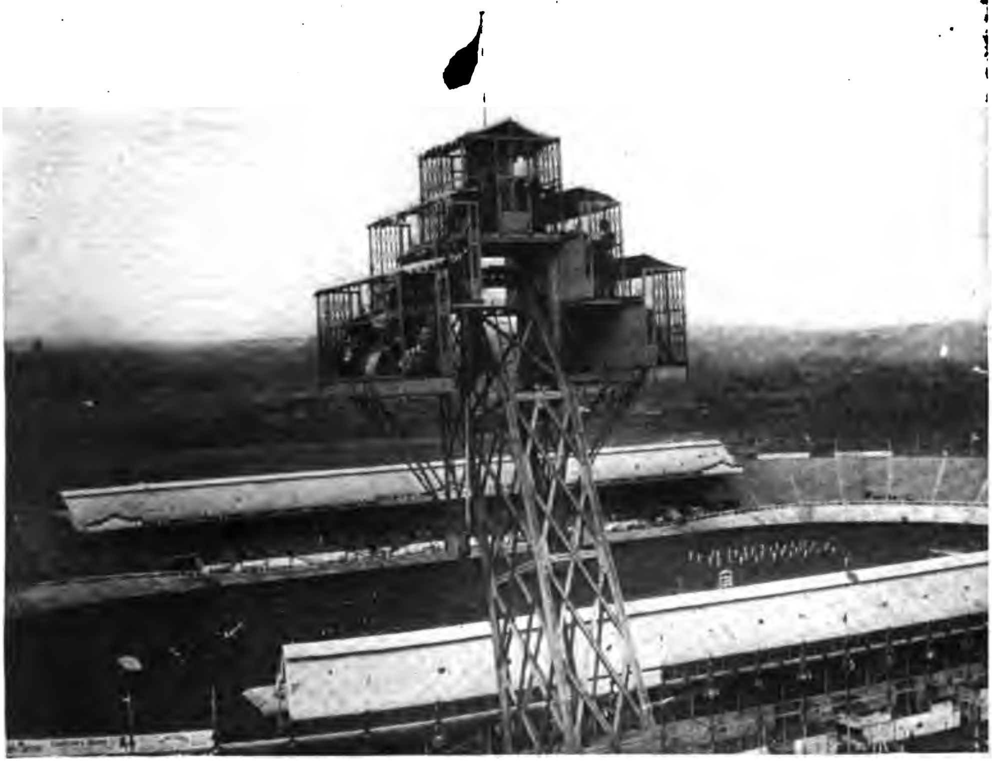

THE "GONDOLA" OF THE "FLIP-FLAP."

THE FLIP-FLAP—A NEW SENSATION

By FRITZ MORRIS

TO provide a new sensation is the principal ambition of every man who projects an exhibition or entertainment. For the ordinary sensations have palled upon people, the majority of whom seem to be like the Russian grand duchess on the rich American's yacht who cried, "I would give anything I have for a new sensation"; and amusement-purveyors must be like that rich American, who, to gratify his guest's craving, promptly ran his yacht ashore, wrecking it on the beach. This hunger for new thrills insures the financial success of any contrivance that looks dangerous enough; it must, however, belie its appearances. The latest of these thrillers is the "flip-flap," which has been one of the most popular side shows of the Franco-British exhibition in London. This consists of two arms 186 feet long, pinioned together near their bases, and swinging vertically like a gigantic pair of shears. On the outer end of each is a cage with seats for forty-eight persons arranged in tiers so that each passenger may have an unobstructed view over the surrounding country. These cages swing on pivots and have counterbalancing weights which maintain them always in a vertical position.

An electric motor drives the mechanism which makes the arms of the flip-

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flap move. They are loaded in the horizontal position from platforms at which they are anchored. A signal to the engineer starts the arms upward, each describing a semicircle in the air, and the passenger-laden cars pass each other at the topmost point, which is 170 feet from the ground. The trip from the horizontal back to the horizontal occupies about three minutes, and the total distance traversed is about 470 feet.

This development of the old-fashioned Ferris wheel was designed by Claude W. Hill, an English engineer. The arms are made of latticed steel and at their lower extremities are weighted with iron boxes filled with concrete. These weights about balance the cars when these are laden and make a minimum of power necessary to raise, and lower them, besides insuring the safety of the passengers. The mechanism is simple but powerful and there are several devices which automatically stop the machinery in the event of any accident, or even of the accidental withdrawal of one of the bolts that anchor the arms at the landing stages.

The sensation of a trip in the flip-flap can scarcely be so thrilling as that of being wrecked on the rocks, but it is said to be very like that of going up in a balloon. At any rate it has pleased so many people that they stand in line all day waiting for their turns to ride in the cars, and hence the projectors are coining money from this device, which was so expensive to build.

He Came Not

He came not,—no, he came not;
The night came on alone;
The little stars sat one by one
Each on his golden throne;
The evening air passed by my cheek,
The leaves above were stirred,—
But the beating of my own heart
Was all the sound I heard.

Fast silent tears were flowing,
When some one stood behind;
A hand was on my shoulder,
I knew its touch was kind:
It drew me nearer, nearer;
We did not speak a word,—
For the beating of our own hearts
Was all the sound we heard.

—R. M. Milnes.

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ENGINEERING PROGRESS

GAS MAINS LAID WITH MOTOR TRUCK

THE motor truck—of three tons weight—shown in the illustration, is employed at Springfield, Mass., for plowing up the streets to lay the gas mains of that city. Much money has thus been saved in labor, inasmuch as this truck displaces a large force of men with picks.

AUTOMOBILE PLOWING TRENCH IN STREET FOR GAS PIPES.

The car is equipped with a twenty-four horse-power water-cooled engine of the two-cylinder type. The horizontal cylinders are six inches in diameter, with a seven-inch stroke.

LOGGING UNDER WATER

THE scarcity of pine timber in the Middle West has impelled the lumber mills to engage in a novel undertaking, by which they hope to save millions of dollars' worth of logs which now lie at the bottom of the Mississippi and other rivers.

For more than fifty years logging has been carried on by rafting pine logs down this great highway, the logs being floated down the Mississippi to a point just north of St. Paul, where they are gathered up and made into rafts. From this point they are floated down the river to the various mills, guided by small steamboats or tugs.

It is the general belief that the river bottom is literally paved with pine logs as far south as Dubuque, Iowa. It has been proved that logs submerged in this way can be raised with great profit. The plan is to lift these logs with a hoisting engine erected on a flat boat, place them on the river bank, and have a govern-

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ment scaler inspect them and record the marks found thereon. Each lumberman has a private mark which is affixed to every log. When the original owner of the lost logs can be found he will be compensated at the rate of $8 per 1,000 feet. This represents just so much profit to the owner and still leaves a fair margin of profit to the hoisters, who can find a ready market for the reclaimed logs at from $12 to $14 a thousand feet.

Sound pine logs do not deteriorate when submerged in water, no matter how long they remain. Logs which have lain under water for half a century are found to be in perfect condition, and lately some of the best lumber produced has been that from some gigantic pine trees that were felled some score years ago and became drawn down in one of the neighboring lakes by the waterlogging of hardwood timber with which the raft was bound. The entire raft, chain bound, was lifted, and half a million feet of perfect timber was recovered.

Other streams in Minnesota and Wisconsin, where logs have been rafted for years, will be explored by the company now formed to begin operations on the Mississippi River.

SMOKE STACK THAT WON'T EMIT SPARKS

A SPARK and fire proof smoke stack for railroad engines has just been invented which promises to absolutely fulfill its purposes. After a test of it for a month or more on the Carrollton & Worthville Railroad, in Kentucky, by night, it was demonstrated that not a spark escaped from the stack. So well does the Forestry Department at Washington think of this ingenious invention that it has asked the New York State Public Service Commission to compel all railroads in the State to equip their locomotives with the new stack.

Looking Down Upon the Top of the New Spark-proof Locomotive Smokestack.

The principle which led to the invention of the spark proof stack is that all solids emerging from a locomotive smoke stack, influenced by the pressure of the exhaust, hug close to the edge of the interior of the pipe's circle, and only the smoke comes up through the center. A simple trap catches the sparks and cinders from the edge of the circle and sends them falling down shutes arranged on either side of the stack to the roadway below. The accompanying photograph shows these shutes upon the exterior of the stack and also the spark-trap at the top.

With this device upon all engines traversing through forest regions, millions of dollars in timber may be saved.

HOME-MADE ELECTRIC HEATER

Electric Heater Made at Home by a Boy.

THIS is a convenient form of electric heater, home-make by a boy. It works at an electro-motive force of 220 volts and has a capacity of about 4,000 watts. However, it is so designed that three heats are obtainable by turning the snap-

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switches seen at the right hand side of the heater. This heater actually replaces a coal stove, and as the current is generated by a small water power plant owned by the boy's father, it is at once not only convenient but practicable since it saves the fuel bill.

HYDRAULIC RAM FOR IRRIGATION

A Battery of Hydraulic Rams for Irrigating Orchard Land.

THE accompanying illustration shows a battery of eleven hydraulic rams installed at Sunny Side, Washington, for irrigating 240 acres of orchard land.

Independent drive pipes are employed, but with a single discharge pipe common to them all. The efficiency is the same with a battery ram as with a single large machine. Only a portion of the rams need be operated when the demand for water is less than the maximum output.

Machine Which Both Wraps and Addresses Newspapers.

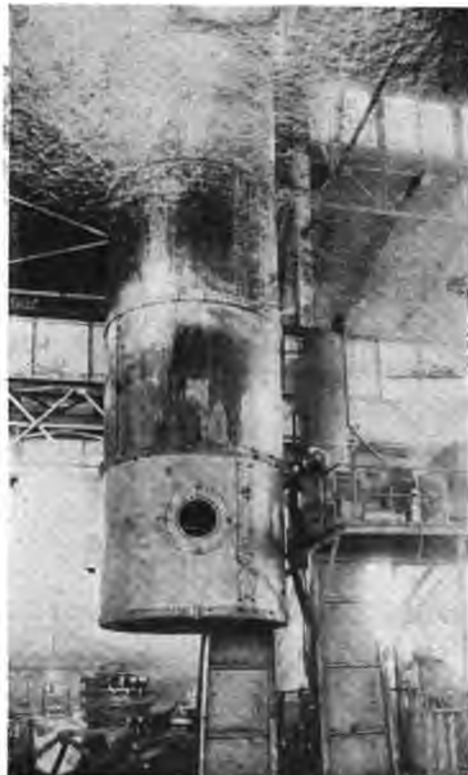
Moreover, the installation of a battery also allows the cleaning of the valve without shutting down the entire plant.

The Sunny Side plant is located at the foot of the Snipes Mountain and consists of eleven 6-inch rams. The photograph was taken before the drive pipes were covered in order to illustrate the details of construction.

MACHINE WRAPS AND ADDRESSES PAPERS

A NEWSPAPER wrapping machine and an addressing machine have been combined in one. Both machines are attached together and are run from one common main shaft. Mounted upon the frame of the wrapping machine at either end are two hoppers into which the papers are fed in bundles as they come from the press. From these hoppers they are fed from the bottom alternately into the wrapping mechanism, where the wrapper is placed about them and pasted. By means of a set of high speed rubber rolls the papers are extracted from the wrapping mechanism and fed into the addressing machine. Each paper is wrapped with a one-half revolution of the main shaft, thereby giving the machine an output in wrapped and addressed papers of twice the speed of the drive shaft.

The addressing machine is equipped with a magazine of galleys in which are held the addressing "slugs," or plates,



A Section of the Great Niagara Falls Penstock.

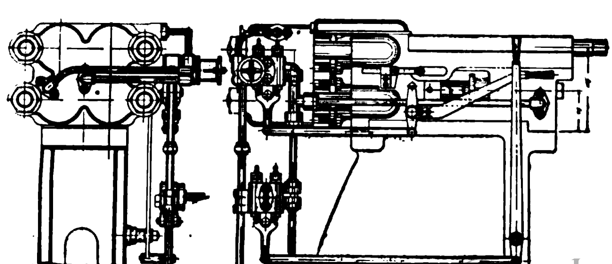
on which are set the names and addresses. This magazine will hold between four and six thousand such names and addresses. They are run through the machine continuously without a stop. The addressing machine is also equipped with a device whereby the papers are automatically segregated or distributed according to the various post offices or routes. This distributing device is purely mechanical and positive. All motions of the machine are positive, making it physically impossible for the machine ever to go wrong unless there should occur a breakdown. The machine is said to have been thoroughly demonstrated under all conditions and sizes of paper, from 8 pages to 144, doing equally good work upon all sizes. It has been run at speeds varying from 6,000 to 9,000 papers per hour, 7,500 being found the best speed at which to operate the machine.

RIVETING THE NIAGARA FALLS PENSTOCK

SPECIAL riveting tools were required in the building of the great Niagara Falls penstock. A section of the penstock, 35 feet long and 10½ feet in diameter is shown set in the jaws of an 18-foot 6-inch Gap hydraulic riveter, in the accompanying illustration. This is in the great foundry and forge plant at Toronto, Canada. The steel plates used in its construction are three-fourths of an inch thick. The hydraulic riveter has quadruple plungers and the cylinders are fitted with a distributing valve attached to the balanced main valve for operating the same. There are three pipe connections for working the plungers. When working with fifty tons pressure the valve is set to the central pipe, which connects to the two opposite cylinders.

When working with 25 tons pressure it is set for the top pipe, and when working with 75 tons pressure it is set to work by the central and top pipe connections. When working with 100 tons pressure the valve is set to work from all three pipe connections. This riveter can be worked at 25, 50, 75 and 100 tons pressure. The four plungers are the same size, 6¾ inches in diameter. With 1,500 pounds pressure they will give a total pressure of 100 tons. This riveter has an adjustable stroke up to six inches.

The accompanying drawing shows the construction of the working mechanism of the riveter with quadruple plungers of equal areas with a maximum pressure of 100 tons on the rivet, and having a variable stroke up to six inches.



The Working Mechanism of the Riveter.

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A REALLY WONDERFUL CLOCK

THIS giant chronometer, which was invented and perfected at Baden, Germany, after thirty years of patient labor and at great expense, gives evidence of close study and considerable ingenuity.

It is ten feet high, ten feet wide and three feet deep. The case of solid oak consists of three parts. The lower contains a complete calendarium, which gives the date, week-day, month and year, and the intercalary day of the leap-year, the golden number, the Epacts, the Roman Indiction, the cycle of the sun, the Dominical letter and the movable holidays—as Easter.

Ten dials in the center of the second part, show the time of the ten principal cities of the world. The central dial has a third hand, to which is attached a little disc, and shows the variations of the sun time from the mean time for every day of the year. To the right is a twenty hour dial, showing the new division of time coming into vogue in Europe and America, according to the decimal system. To the left a twenty-four hour dial gives accurately the siderial time, which time advances on the mean time every twenty-four hours—three minutes and fifty-six and one-half seconds.

The upper part to the right of center exhibits four figures, representing the four ages, namely: childhood, youth, manhood and old age, which strike the quarters. An angel protects with its right hand the first three ages, while it remains quiet at the approach of old age. As soon as this figure has struck the fourth quarter, another angel reverses an hour glass, intimating thereby that the human life is ended, whereupon death strikes the hour. To the right of these figures can be seen a dial, showing sunrise and sunset for every day in the year, also showing distinctly the lengthening and shortening of each day. Above this the moon can be seen in her different phases of rotation, with her exact daily increase or decrease. To the left there is a Planetarium, which gives the heliocentric movements of the six principal planets—Mercury, Venus, Earth, Mars, Jupiter, and Saturn. The plate upon which the planets move contains also the signs of the Zodiac, divided into 360 degrees, a hand showing the position of the sun by degrees in the Zodiac for each day of the year. This particular division of the clock was accomplished only after infinite labor and calculation.

CLOCK WHICH REPRESENTS THIRTY YEARS OF LABOR.

To the right of the clock is a globe, representing the Earth, which revolves upon its own axis, from west to east, making one revolution every twenty-four hours, and according to its meridian, all dials can be accurately set to their exact time. On the opposite side is a globe representing the stars or heavenly constellation, which revolves upon its own axis from east to west—siderial time—just the reverse of the Earth, showing those stars directly above us, also those which are rising and setting.

In the center of the upper part of the clock the twelve disciples appear successively every noon hour. Each disciple moves towards the Lord, who stands in a niche, receives the benediction and then disappears. During the procession of the disciples an organ plays several beautiful sacred hymns, and immediately after the disciples have made their procession a cock is heard to crow three times.

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The Modesty of Mary

MISTRFSS—"Why, Mary, this figure of Venus is covered with dust."

MAID—"Yes'm."

MISTRESS—"Didn't I tell you to brush it off?"

MAID—"Yes'm."

MISTRESS—"And why didn't you?"

MAID (blushing)—"Because, mem, I thought it needed something on it."—*Bohemian.*

A Worthy Desire

AN ambitious young Chicagoan recently called upon a publisher of novels in that city, to whom he imparted confidentially the information that he had decided to "write a book," and that he would be pleased to afford the publisher the chance to bring it out.

"May I venture to inquire as to the nature of the book you propose to write?" asked the publisher, very politely.

"Oh," came in an offhand way from the aspirant for fame, "I think of doing something on the line of 'Les Miserables,' only livelier, you know!"—*Lippincott's.*

Why They Moved

"MY wife wants to buy a little dog."

"Yes?" queried the dealer. "What kind?"

The customer looked about anxiously. "Oh, a little one. I'll tell you," he went on, solemnly flapping his hands up and down; "one that wags his tail this way."

"What?"

"We live in a flat. There isn't room for a dog that wags his tail sideways."—*Suburban Life.*

The Caller One of Them

"MY dear," said the caller, with a smile, to the little girl who occupied the study while her father, an eminent literary man, was at dinner, "I suppose you assist your father by entertaining the bores?"

"Yes, sir," replied the little girl, gravely; "please be seated."—*Judge.*

Doctoring to Suit the Patient's Taste

PATIENT (from a sanitarium, in a rage)—"Here, doctor, you've been treating me for heart disease. The specialist has treated me for the liver."

COUNTRY DOCTOR—"Well, I can do so too."—*Fliegende Blaetter.*

In the Library

"WOULD you mind changing this for me, mum? It's the second edition, and I haven't read the first."—*Harper's Magazine.*

One Woman's Wisdom

HER HUSBAND—"My dear, how did you happen to employ such a pretty nurse girl?"

HIS WIFE—"I didn't happen to do it. I did it because I wanted the children to have police protection when they are in the park or on the street.—*Chicago News.*

What Makes the World Go Round?

TOPER—"An' yet they say it's love that makes the world go round."—*Harvard Lampoon.*

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"Without"

The German girl who presided over the soda fountain in Heckelmeyer's drug store was accustomed to patrons who did not know their own minds, and her habit of thought was difficult to change.

"I'd like a glass of plain soda," said a stout man, entering one day in evident haste as well as thirst.

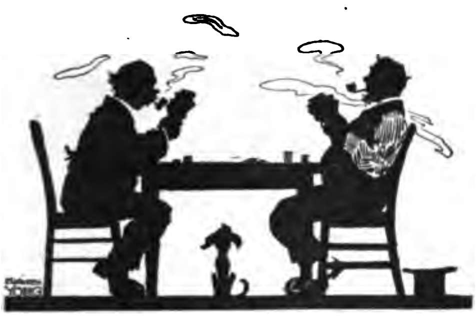
"You have vanilla, or you have lemon?" tranquilly inquired the young woman.

"I want plain soda—without syrup. Didn't you understand me?" asked the stout man, testily.

"Yas," and the placid German face did not change in expression or color. "But wat kind sirup you want him mitout? Mitout vanilla, or mitout lemon?"—*Youth's Companion.*

At the Card Table

HORAN—"Is O'Brien a good bluffer?"



DORAN—"No; whiniver he gets a shpade he spits on his hands."—*Illustrated Bits.*

Poor Nervous Women

THERE are nervous women; there are hypernervous women. But women so nervous that the continual rustle of a silk skirt makes them nervous—no, there are no women so nervous as that!—*Fliegende Blaetter.*

"WHEN I get to heaven I am going to ask Shakespeare whether or not he wrote those plays."

The husband chuckled.

"Maybe he won't be there," he said.

"Then you ask him," said the lady.—*Washington Star.*

The Seats Were Safe

"IT would please me mightily, Miss Stout," said Mr. Mugley, "to have you go to the theater with me this evening."

"Have you secured the seats?" asked Miss Vera Stout.

"Oh! come now," he protested; "you're not so heavy as all that."—*The Catholic Standard and Times.*

Something Soulful

"YOU are going to say something soulful," declared the fiancé. I see it in your lovely eyes."

"What I was going to say is this," responded the fiancée. "Won't you wear a rubber band around your head nights, so as to train your ears not to stick out?"—*Louisville Courier-Journal.*

Preliminary Training

UNCLE JOSIAH—"First time you ever milked a cow, is it? Well, you do it a thunderin' sight better than most city fellows do."

VISITING NEPHEW—"It seems to come natural somehow. I've had a good deal of practice with a fountain pen."—*Chicago Tribune.*

Aunt Mahaly's Expedient

"THESE stockings are so full of holes that they are worthless, Aunt Mahaly," said a lady to an old colored woman with a large family, who was a pensioner of her family.

"No'm, dey ain't," replied Aunt Mahaly, calmly appropriating them. "Ra'stus en' Verbena got such black laigs dat de holes won't show, nohow, en' dem chilluns what got yaller meat kin wear two pairs at de same time; en, you knows, Mis' Jo, dat de holes in all dem stockings' ain't gwine hit de same places."—*Youth's Companion.*

Slippery

PATIENCE—"I see dainty Indian muslins are made from fibers of the banana-tree."

PATRICE—"They ought to be easy to slip on." —*Yonkers Statesman.*

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SCIENCE AND INVENTION

WEATHER SUB-STATIONS CREATED

THE accompanying photograph illustrates the first weather sub-station to be erected in the United States. It is one of the twenty to be placed in various large cities of the United States. If they prove of as much service to the public as is expected of them they will be put in general use. The money comes out of the regular weather bureau fund.

The handsome little structure is ten feet square by fifteen feet high. A barometer, thermometer, hydrometer and rain gauge are placed behind a screen of glass on one of its four sides, while the others are used for the display of maps and bulletins.

ONE OF THE TWENTY WEATHER SUB-STATIONS TO BE PLACED IN VARIOUS LARGE CITIES.

Singularly, no time-clock is displayed. Electric clock-work is used to turn the cylinders of the self-registering machines. The amount of rainfall is shown on the gauge after the rain has been caught on the roof, and led down the interior of the station where it is accumulated in a tank and automatically measured and recorded.

The barometer shows the approach of a storm or fair weather; the hydrometer indicates the humidity of the air.

HYDRAULIC HOIST AT ENGLISH DOCKS

AT Leith, England, recently there was erected at the Imperial Dock a movable hydraulic coal hoist designed for dealing with end tip wagons of a gross weight of thirty tons, these wagons to be hoisted above the quay for a distance of over sixty feet and then tipped.

The hoist consists of a steel framing mounted on eight double flanged wheels on rails. Moving inside the framing and guided therefrom is a cradle about twenty-seven feet long fitted with a tipping frame hinged at the front of the cradle. The lifting and tipping machinery is placed on one side of the framing, the lifting machinery consisting of two hydraulic cylinders with rams working downwards, one of these rams being in constant communication with the accumulator, to balance the weight of the cradle, etc. The tipping cylinders are placed on the upper part of the lifting cylinder.

The lifting of the cradle is effected by two wire ropes, one attached to each side

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AN HYDRAULIC COAL HOIST IN USE AT LEITH, ENGLAND.

of the upper part of the cradle and thence carried over conveyance sheaves on the top of the framing to a sheave on the heads of the lifting rams. The tipping is done by two wire ropes attached to the rear end of the tipping frame and passing thence over the conveyance sheaves on the top of the framing to the tipping and lifting cylinders.

The front of the framing is fitted with a chute which can be adjusted and fixed at any height required up to the maximum height of sixty-one feet. The movement of the point of the chute is effected by an hydraulic cylinder and ram placed vertically on the side of the framing, to which wire ropes are led from the chute point over the conveyance sheaves on the upper part of the framing. The movement of the heel of the chute is effected by temporarily attaching it to the cradle by means of hinged levers, racks and pawls being provided for securing it after adjustment. The chute is fitted with double doors near the point. The hoist framing is arranged so that an anti-breakage crane can be added hereafter, if found necessary.

AMERICAN BUILDS SECTIONAL RACING SHELL

THE first sectional eight-oared shell ever built in this country, and recently completed, is shown in the illustration at bottom of page. Hitherto sectional shells for racing have been purchased in England. The length of this craft over all is about sixty feet. The cost was $550. It was built for the Duluth Boat Club, of Duluth, Minnesota.

CAR LEAPS UPON ANOTHER

A FREAKISH wreck recently occurred in the yards of the Missouri, Kansas & Texas Railroad at Greenville, Texas. A collision between two trains occurred and one flat car sped through the air and alighted upon another flat car. It was loaded as neatly as if the most modern methods of machinery and

SECTIONAL RACING SHELL. THE FIRST TO BE BUILT IN THE UNITED STATES.

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CURIOUS WRECK IN WHICH ONE CAR LOADED ITSELF ON ANOTHER.

human ingenuity had been employed. The car did not even leave its trucks, and about the only damage done to it was the shattering of some of the timbers upon one end. The car which thus loaded itself upon another was hauled to the shops, in the position it took when it alighted, and was placed in repair.

In the annals of railroad accidents there have been many curious freaks reported. This particular one, however, is of a somewhat unique character.

ONE HUNDRED THOUSAND PIGEONS

WHAT is claimed by the owners to be the largest pigeon farm in the world is located at Los Angeles, California. By actual count, there are cotes for more than 100,000 of the birds, and every nest is occupied, with numbers of the birds roosting on outbuildings and in temporary nesting places. This gives the unique farm a population of considerably more than the one hundred thousand feathered inhabitants claimed for it.

The birds eat two tons of wheat each day, with large quantities of green stuff and other foods, of which a regular account is not kept, as it is obtained from surrounding farms in exchange for fertilizer from the pigeon ranch. When the birds are disturbed at their eating they rise from the ground in huge white clouds, spotted here and there with patches of blue and rufous coated pigeons. Of late years, however, and the pigeon farm has been in operation

AN ARMY OF PIGEONS ON THE LARGEST PIGEON FARM IN THE WORLD, AT LOS ANGELES, CALIFORNIA.

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Test of the New Change Board at the Hoboken Terminal of the Hudson River Tunnel.

for a number of years, the colored birds have been gradually weeded out until now the population of the place is practically all made up of snow white birds.

In the nesting season, when the cotes are full of young, and eggs, the pigeons stay close around the farm, but at other times of the year they gather in great white clouds over Griffith Park, the largest city park in the world. At feeding time they fly about the three men constantly employed to care for them, settling on their shoulders, heads and arms, even trying to get into the feed sacks, from which the wheat is thrown in great scoopfuls.

The product of the farm, squabs, young birds, and adults goes entirely to the large hotels of Los Angeles and of the surrounding resorts.

TO FACILITATE MAKING CHANGE

THE change board, shown in the accompanying cuts, is an invention by a resident of New York.

Everybody who has used the elevated road or the subway knows of the great difficulty that is experienced in picking up change from a glass plate and this is especially true with women who are carrying children or bundles and only have one hand free. The difficulty is also increased in the winter season when gloves must be worn.

The board itself is nothing more nor less than a deep saucer, one side of which is tapered up on a long angle until it comes flush with the table from which the change is handled.

In using the board, the change is simply slipped down the incline into the saucer and by putting all of the fingers of the hand over the money and closing the fingers in towards the palm, all of the change is instantly picked up by one movement.

It has been found in actual practice that between 1,500 and 1,800 people per hour can be passed by a single window where this board is in use, while the maximum number that can be passed in the old way is between 350 and 400, and there is no doubt that when the public becomes accustomed to the use of the board that even a greater number can be passed in the same time.

In addition to this, the ticket sellers

Each Person in Line Quickly Picks Up His Change and Passes On.

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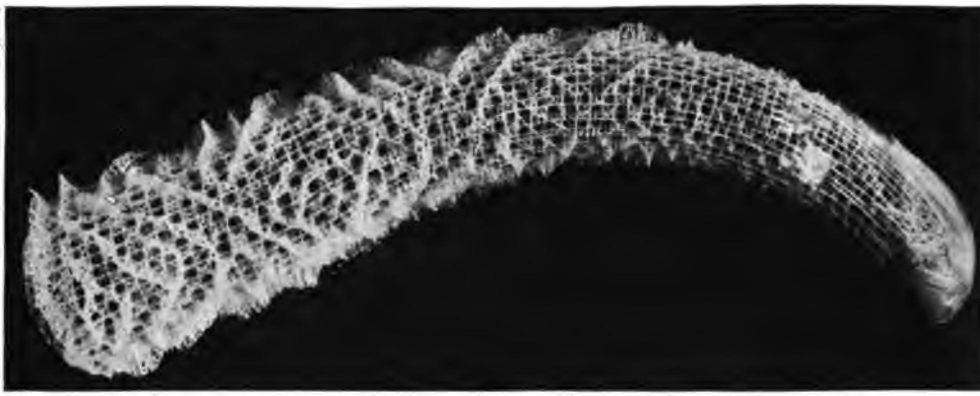

THE GLASS-SILK SPONGE. THE FIBER OF WHICH IS WOVEN INTO FILTER CLOTHS.

find that they can throw out the change with a much greater velocity, as there is no danger of pushing it over the plate as there is at present.

GLASS-SILK FIBER FURNISHED BY SPONGES

VENUS'S Basket is a glass-silk sponge which grows in the warm, tropical seas of the Pacific, from the Fujiyama region to the Indian Ocean. By the Japanese it is called the mineral-silk sponge, and is used for its fiber, which is woven into chemical filter-cloths; into fireproof candle-shades, and into delicate fireproof curtains. The specimen of glass-sponge here illustrated, in its natural state was covered with these long silky fibers which are used in the arts spoken of. A small tuft of these fibers may be seen covering the base. The specimens are raked up from the ocean bed, and the framework which cannot be separated into fiber for weaving is used in covering steam pipes and in cold-storage insulation, where it has been found to equal asbestos. Some specimens are fully forty inches in length and three to four inches in diameter.

ELECTRIC EGG-BEATER WIRED FOR USE.

HOME-MADE ELECTRIC EGG BEATER

A KITCHEN utensil of more than passing interest is an electrically operated egg-beater. It is the more interesting because it was designed by a boy. The motor which is of one-eighth horsepower capacity is so connected to the egg-beater that the latter may be quickly removed for cleaning. By means of a snap-switch and a home-made rheostat, consisting of spirals of resistance wire wound on porcelain bushings, three speeds may be given the egg-beater. The whole apparatus is fixed to a bracket which extends outward from the wall over the kitchen table, and just high enough so as to be within about an inch from the table top.

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These green-robed senators of mighty woods,
Tall pines, branch-charmed by the earnest stars,
Dream, and so dream all night without a stir.

—KEATS.

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THE TECHNICAL WORLD MAGAZINE

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WHO OWNS THE EARTH?

IV. TERRIFIC WASTE OF NATURAL GAS

By COULEY H. PURDOM

The publication of Mr. Hyde's series on the conservation of our natural resources is interrupted to make room for this extremely timely and striking article, which illustrates the reckless way in which Americans wantonly waste nature's great gifts to man. Mr. Hyde's next article will appear in May.

NATURAL gas sufficient to light the streets and homes, heat the buildings and turn the factory wheels of every enterprise in Chicago, St. Louis and New Orleans is going to waste in the Caddo gas and oil fields near Shreveport, La., at the rate of 100,000,000 cubic feet a day.

Gas is rushing from the bowels of the earth through two wild wells and over fifty gas and oil wells left uncapped. The crater of one wild well covers over two acres.

The attention of President Roosevelt has been attracted to conditions and by his order all public lands lying in Caddo and Bossier parishes have been withdrawn from entry until the government may take what steps are deemed necessary to stop the terrific waste and preserve what is conceded to be the greatest gas field in the Western Hemisphere.

In the meantime, the city of Shreveport is thronged with oil investors from every section of the country, rival claims have been filed on government lands near the oil wells, the price of real estate has reached heretofore unheard of figures, men who a few months ago held nothing but a few scant acres of cut over pine lands now count their wealth by the thou-

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sands, and armed guards stand watch over ground which is claimed under various acts and entries applicable to the securing of public lands.

Representatives of the large gas and oil companies are on the ground in an effort to buy up the lands, the usual real estate man with his blue prints is greatly in evidence, and the oil and gas boom is fairly under way.

AN APPALLING WASTE OF NATURE'S GIFTS.
Gas from this burning well is escaping at the rate of 50,000 cubic feet a day. The flames from the crater, which is 100 feet wide—throw a glow on the sky which may be seen at night thirty miles away.

Oil City has sprung into existence, with the usual wildness of a boom town; bootleggers, gamblers and their accompanying satellites give the authorities considerable trouble.

Lands bought at prices ranging from $500 to $1,000 an acre are of court record and the Caddo gas and oil fields are attaining that importance which their discoverers have long expected.

A corps of experts, in the employ of the government, has completed a survey of the field, and a report as to what conditions really are—from a waste-of-gas viewpoint—will soon be submitted to the President and the Secretary of the Interior, following which, steps are expected towards stopping the almost criminal waste of gas now going on.

The Caddo gas and oil field is in the northwest corner of Louisiana. It takes its name from Caddo parish—Louisiana counties are called parishes—in which is located the second city of the state, Shreveport.

The gas territory virtually begins at Shreveport and has been proved as far north as Dixie, La., thirty-four miles. It is measured on the west by the Trees Oil Company's well near Loggy Bayou, which is six furlongs from the Louisiana-Texas line, and the gas wells at Dixie, twelve miles from Loggy Bayou, show its eastern extension. This makes the proved gas territory thirty-four miles long by twelve miles wide, showing a total area of 408 square miles. The oil field shows a lesser area, all of which

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lies within the region which constitutes the gas belt.

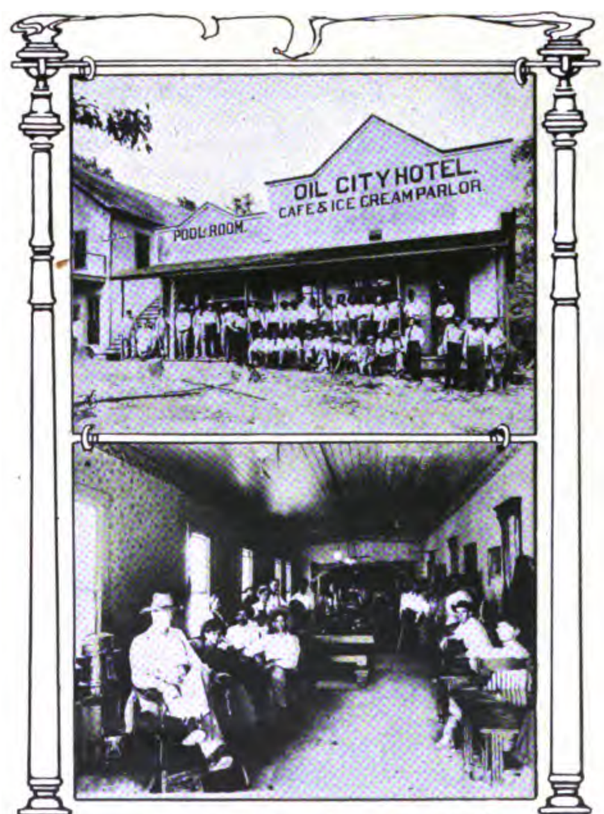
This territory is underlaid with two strata of gas sand, averaging from forty to 140 feet in width, the first 800 to 900 feet beneath the surface and the second lying between 1,800 and 2,200 feet. The gas sands show their greatest width at Mooringsport, which lies in the more southern portion of the field.

The gas field was discovered five years ago. The first well was drilled by Savage Brothers and Dr. Morical, who were attracted to the field by reports of a section where gas was escaping from ordinary water wells sixty and seventy feet deep. They brought in the first oil well in the spring of 1904. The fact that gas existed in great quantities was proved some time later when the first "gasser" was developed by K. W. & C. W. Brown. This well today is a good producer.

Messrs. Savage and Dr. Morical are old men and attained the honor of discovering the Caddo field after two of the three partners had crossed the span of allotted years given man on earth and the other was near the three score and ten mark. J. S. Savage was seventy-three years old, his brother, Al, counts his winters at even seventy, while Dr. Frank Morical is past sixty-five. The three veterans of many fields are still prominent in the Caddo's development and are as energetic as the younger drillers who have entered into the field since the three gray-haired pioneers blazed the way and demonstrated that both gas and oil lay in paying quantities around the waters of the Caddo lakes.

Water is the bane of the operators—water on the surface and brine—which sometimes threatens the well as the drill sinks deeper into the earth. The Caddo Indians, from whom the parish is named, handed down a bit of history which treats of the surface water's formation, and is at the same time of interest in relation to the gas deposits found underneath. They claimed that once the oil section was as the other hill lands of North Louisiana; one night there came a great explosion, the lands sank and Red River poured its waters into the basin hastily formed by nature, and the lakes were born. This is only a story, related by the gray-haired men around Mooringsport, who say the Indians told their fathers, but in the lake bed are stumps of oaks and other trees which do not grow in swampy lands, and geologists give credence to the legend thinking there might at one time have been another gas stratum nearer the earth's surface, and when this gas escaped the lands fell and the lakes were formed.

Regardless of the lakes' formation, the



"Rough Row" and Interior of Its Pool Room, at Oil City.
In this row, recently destroyed by fire, the grand jury voted gambling and other illegal practices were being carried on.

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STORAGE TANKS AND PUMPING

lands lying in the north end of the parish are of a swampy nature and practically worthless for farming purposes and not being entered as homesteads remained, to a great extent, part of the public domain. As the oil developments began to increase this fact attracted attention and various kinds of public lands entries were filed on those tracts for which title has never passed from the government.

As soon as it was demonstrated that gas existed in paying quantities there began to be talk of a gas line to Shreveport. Local capital, to a great extent, hooted at the idea and refused to aid the enterprise. At last S. S. Hunter, W. B. McCormick, A. H. Leonard, J. W. Atkins and other local business men of means formed a company and constructed the line. It proved a success. It was eventually sold to the Dawes interests, of which Hon. C. G. Dawes of Chicago is the head, bringing a handsome profit to the original builders. This was in 1906 and with the exception of a few local men efforts to develop the field to its full extent had proved rather lukewarm. About this time a gas well, near where Oil City now stands, broke loose from all control, blew out the casing and entered upon the most rampant waste of natural gas known in the history of the American fields. Escaping gas tore a large hole in the earth, soon the well caught fire and became known as the burning well of the Caddo field. The Dawes interests spent thousands of dollars in an attempt to get it under control and offered a standing reward of $15,000 to any one who might harness it. The hole grew greater and at last covered over two acres of ground. From this crater the gas escapes at a terrific rate. It comes from the earth with a great roar. Water and mud roll back from the escaping gas, boiling and seething, as if issuing from the crater of some volcano. The white misty gas rushes from the great hole into the air, the fire catches it and flames leap far above the pine tree tops.

The heat is so intense that spectators view the burning well from a distance. The blaze acts in a spasmodic manner. Now it burns quietly as if it were some huge taper set to furnish a beneficent light, then gas rushes forth with a roar, the flame springs higher and the surrounding earth trembles, and causes the nearest approach to an earthquake possible without the reality being experienced.

This gas well, with its estimated output of 50,000,000 cubic feet, is not alone in the work of waste, there is another hardly a half mile from the greater, which must be producing 25,000,000

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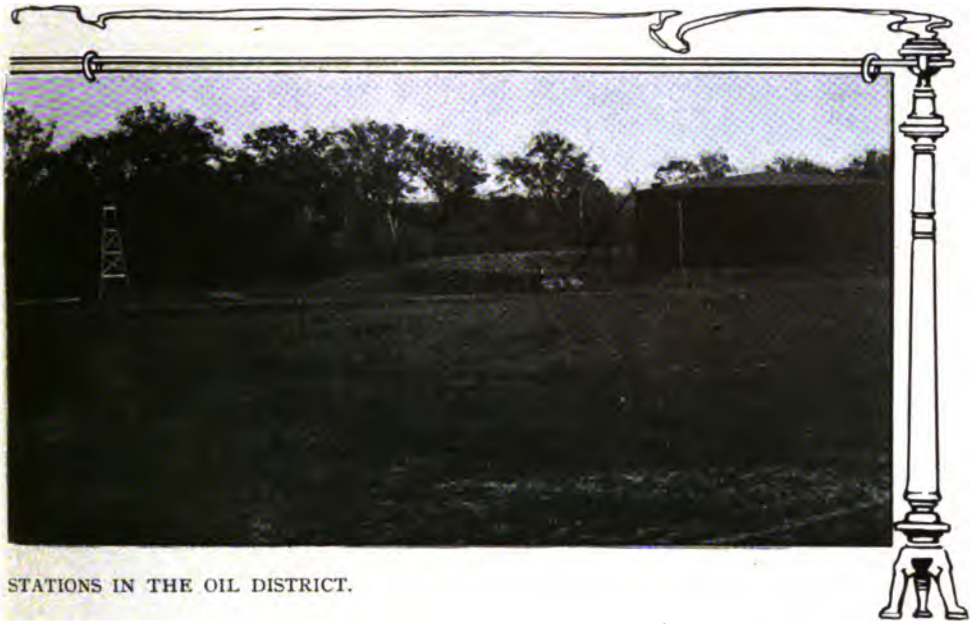

STATIONS IN THE OIL DISTRICT.

feet, and it is only a question of time before its output will be equal to that of the first of the wild wells. The flames from the escaping gas cast a glow over the skies which is seen at night from a distance of fifty miles, and birds passing over the blaze often fall to the ground scorched and dying.

The President's notice was called to this almost criminal waste during the latter part of the year. The field had begun to attract attention throughout the country. Capitalists were hurrying to the scene and government lands were being taken up. Like a flash came the order withdrawing from entry all portions of the public domain and holding up final action on those already filed on.

This was in the latter part of 1908. The field was claiming the oil men's attention from the various other fields. Oil City had sprung into sudden existence, though many of its citizens lived in tents, while hotels, pool rooms and blind tigers rose on every side.

Then the scene of activity shifted to Mooringsport, where the Gulf Refining Company had been drilling for some time. The well was capped and the company refuses to give out any information regarding its condition. Rumor claimed it was a 10,000-barrel producer. "Piney Woods" Joe Noel, who paid $200 for 160 acres of cut over lands, sold out for $50,000.

The Busch-Everett Company entered the field and in a week's time spent over $250,000. It paid W. E. Noel $100,000 for 4,000 acres of cut over timber lands, and S. A. Guy, who was instrumental in interesting Adolphus Busch in the field, cashed in his holdings for considerations said to exceed $200,000 in value. Since then the Busch-Everett Company has secured over 40,000 acres in Bossier parish, across Red River from the proved field, making its total holdings exceed 50,000 acres, while it is rumored that this company is contemplating laying a gas line to St. Louis.

The Gulf Refining Company bought forty acres from R. H. Ward at $20,000. Ward held the land under a soldier's warrant while Kendall and Belcher covered the same tract of government land with a mineral claim. Armed guards in the latter's employ took possession of the tract, a five strand wire fence was placed around the property and the mineral claim holders began preparations to drill a well. Other tracts were taken possession of in a similar manner and the natives around Mooringsport were thrown into a state of wild excitement.

Farmers who had obtained their property through the homestead laws and had

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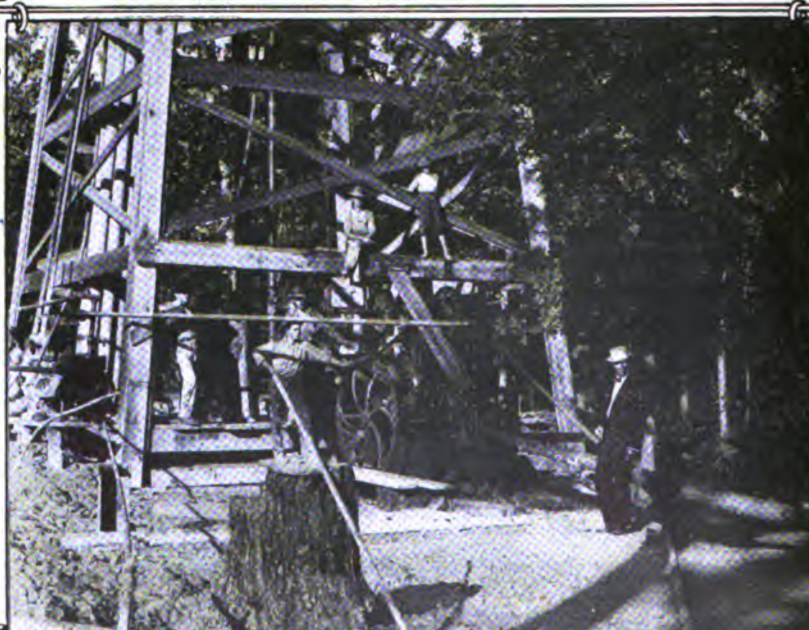
FERRY LAKE, FORMED BY THE LAND SINKING IN A SINGLE NIGHT.

It is believed this phenomenon was caused by oil deposits underneath.

declined offers in the thousands for the scant holdings grew alarmed, fearing they would awake some morning and find their lands held by some oil man with a mineral claim. They armed and for days the woods around Mooringsport presented the appearance of an armed country through which some dreaded enemy was passing rather than a peaceful country which was being developed for its mineral wealth.

This commotion has all been caused by the Hostetter well which has an unknown production, estimated from 100 to 10,000 barrels a day. S. C. Hostetter, a former section hand, on whose property the Hostetter was drilled, sold out for $74,000, while others around Mooringsport have



THE DRILLING OF A SHAFT COMPLETED.

Preparations being made "to bring the well in," but whether as a "gasser" or oil producer is not known.

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met with equally good fortune, and those living within twenty miles of Mooringsport value their sandy soil at fifty dollars an acre.

One young man, James Humphries, owned nine acres. He was earning his $2.50 a day working on an oil derrick. Jim is an elongated individual, slow of speech and of deliberate action. He was wielding a sledge hammer when a stranger approached.

"Are you Jim Humphries?" he asked.

A WELL IN THE WILDERNESS—BORING FOR OIL.
Natural gas is used for fuel with which to drive the engine.

"Yep," responded Jim and continued at his work.

"Do you want to sell your land?" asked the representative of the Gulf Refining Company.

"Nope," replied the oil derrick hand.

"I will give you $9,000 for your nine acres," said the agent. Bang! Down came the hammer.

"Goodbye boys, I have got more money than I ever expected to see in all my born days," called Jim to his fellow workmen. He did not let the agent out of his sight until all papers were signed and he had the cash.

Similar incidents are being told and midnight deals are not uncommon. One was closed after a long automobile ride in order to save an option. The oilman who heard his well had come in, hastily donned his overcoat and hurried downstairs to confirm the story, only to find he was wearing his night shirt instead of a great coat. Others as odd are related to show how intensely the boom has been felt at certain periods during this intense scramble for wealth.

Thirty-four oil wells are now being drilled, a gas line is being laid to Marshall, Texas. Shreveport, Texarkana and a number of smaller towns are already supplied, while rumors of lines to St. Louis and New Orleans indicate further developments from a gas viewpoint.

In the meantime the wild wells are allowing the gas to escape by the 100,000,000 cubic feet a day. These conditions have been in existence for three

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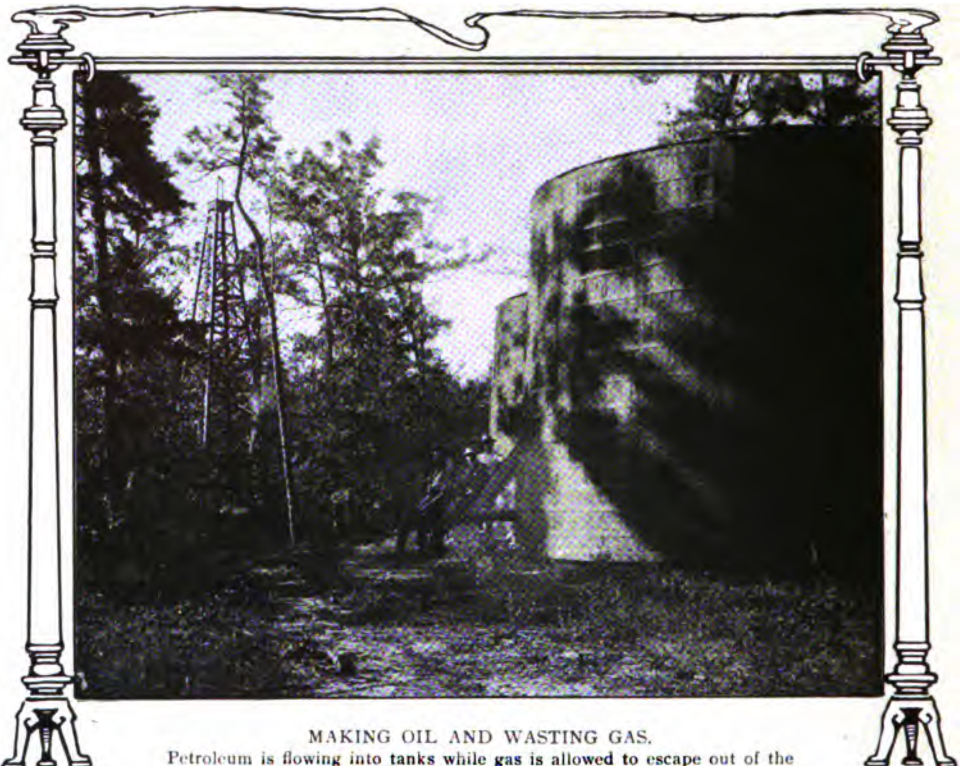

MAKING OIL AND WASTING GAS.
Petroleum is flowing into tanks while gas is allowed to escape out of the pipe at side of derricks. From 500,000 to 1,000,000 feet of gas is thus lost in a day.

years and yet the original wells, showing a pressure of from 350 to 450 pounds when brought in four years ago, today record a decrease in pressure of hardly fifteen pounds.

This causes experts to consider the supply almost inexhaustible and one theory advanced claims that the Caddo oil pool has not yet been discovered and from it the gas is being formed at the present time. J. B. McCann, one of the most experienced oil men in the coastal country, and considered the oracle of the North Louisiana field, says future developments will disclose that there is as much oil as gas in the field and that the great oil pool has not yet been touched by the drills.

Developments for oil are being handicapped by the gas pressure encountered, but charges made to the effect that oil-men are trying to waste the gas in order to facilitate the production of oil are without foundation. The gas pressure is so strong that efforts to control it are often without avail—as was the case with the great wild wells. All interested in the oil fields will view with delight any action taken by the government towards harnessing the wild wells, or the passing of laws governing their future development.

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TO GIVE THE BIRDS A REFUGE

By ROY CRANDALL

Mr. Crandall, who is somewhere on the sunny side of forty, has spent eighteen years in general newspaper work in Buffalo, Chicago and New York. He was contemporaneous on the Chicago Tribune, Herald, News and Inter Ocean—with Peter "Finley" Dunne, George Ade and other brilliant men who have left their nicks in the world of letters. He returned to Buffalo in 1900 to become Director of Publicity of the Pan American Exposition

and after the close of that great Exposition went to New York and became associated with leading New York papers. A year ago he was sent to Washington. He became deeply interested in the vast problems that the army of government scientists have in hand. His contributions in this particular field to the Technical World Magazine during that time have attracted general and favorable attention from many different quarters.

HIGH above the marshy wastes which border the Klamath Lakes in Southern Oregon a lone white heron winged his desolate flight a month ago, his beady telescopic eyes turned now right, now left while from his needle pointed beak dismal and discordant cries sounded a requiem for the departed members of his kind, for he was alone in the world—the sole survivor of a once proud family.

On broad pinions the snowy survivor of a former legion floated to the east and then to the west; the far-seeing eyes searching vainly each stretch of lake, land or sedgy waste for a familiar patch of white which would betoken the presence of father, mother, mate, chick or friend, but he saw none, for President Roosevelt had been too late in setting aside the Klamath district as a National bird reserve and the delay had sealed the fate of the white heron family.

But one is left, according to the officials of the United States Land Office and of the National Association of Audubon societies; just one white sample remaining of myriad thousands of one of the most beautiful of all native birds; the cruel decree of Fashion having brought about so savage a butchery and so per-

A BIRD-BREEDING ISLAND BELONGING TO THE LOUISIANA STATE AUDUBON SOCIETY.
This is one of the spots secure from the visits of the feather hunters.

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SEA GULLS IN FLIGHT.
The gull being a bird of great economic value should have adequate protection from the commercial hunter.

sistent a hunt for white plumage that biological historians will, in future works, record the melancholy fact that in the year A. D. 1908 the white heron followed the great auk over the dismal trail that stretches backwards to the Ages that are gone.

If President Roosevelt had only signed that executive order one year ago—or even six months—the heron would have been saved, but he signed it in September and that was a bit too late. The feather hunters had been more busily engaged in heron massacre than bird lovers suspected and with daily rewards averaging $200 for the slaughter they had worked with feverish haste and Indian like thoroughness. Their work was singularly well done, for the work of these bird murderers, sent out by milliners in search of the artificial aids to Milady's sartorial and "millinerial" aggrandizement, appears to be accomplished only when the birds, which for the nonce are the beloved of Fashion, have been wiped out to the last feather.

That Mr. Roosevelt failed to save the white heron is regrettable—that he tried is commendable. For what he has done in the past birds and biologists will bless his name, while matrons, maids and milliners will make it a hissing for he has shown a consistent desire to preserve the birds from the army of feather butchers and he has done much. During the seven years that he has held the quivering tiller as the Ship of State plunged through smothers of foaming trouble on and off the rocks of approbation and disapproval, he has set aside thousands of square miles of land, water and marsh for bird life and millions of birds have

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HERRING GULL ON NEST—ONE OF A PROTECTED COLONY ON THE MAINE COAST.

seen the feathered death rate decrease to an astoundingly gratifying degree because of him.

In the Atlantic, the Pacific, the Gulf, the Mississippi Delta district, and some of the inland lakes vast stretches have been given over solely to the birds and by law it has been made criminal for anybody to enter those restricted areas to kill a bird or even to take a feather or an egg.

Like Richelieu, the Presidential champion of the feathered ones has thrown about those he would preserve the awful circle of Federal wrath and those who step but one foot within, may rest assured that e'en though they wear a crown on their heads he'll hurl the curse of fine or imprisonment rather than excommunication.

There are points at which the Richelieu and the Roosevelt ways diverge.

Though bird reserves—brought into existence by the President of the United States, who acts as executive agent for the National Association of Audubon societies—may be known of only by consistent bird lovers and bird champions, twenty-one of them now exist; the President having created the last six since the month of August. As has been said, thousands of square miles are embraced within the border lines of these various havens of safety, the land in every instance being unfit for agriculture, invariably being some outlying barren island or key surrounded by marsh and sedges wherein the birds delight to nest and feed.

Off the coasts of Washington, Oregon and California in the Pacific thousands of protected birds now swarm and multiply in safety and in confidence for they are becoming so tame that bird wardens walk among them and brush them from their paths. In the Mississippi Delta districts terns, red breasted mangasers, black skimmers and ducks are increasing at rapid rates; in the lakes of Michigan and North Dakota ducks and cormorants which three years ago were seemingly doomed are quacking and croaking as they watch their young wax fat and

GROUP OF YOUNG WHITE PELICANS ON THE KLAMATH LAKE RESERVATION, OREGON.

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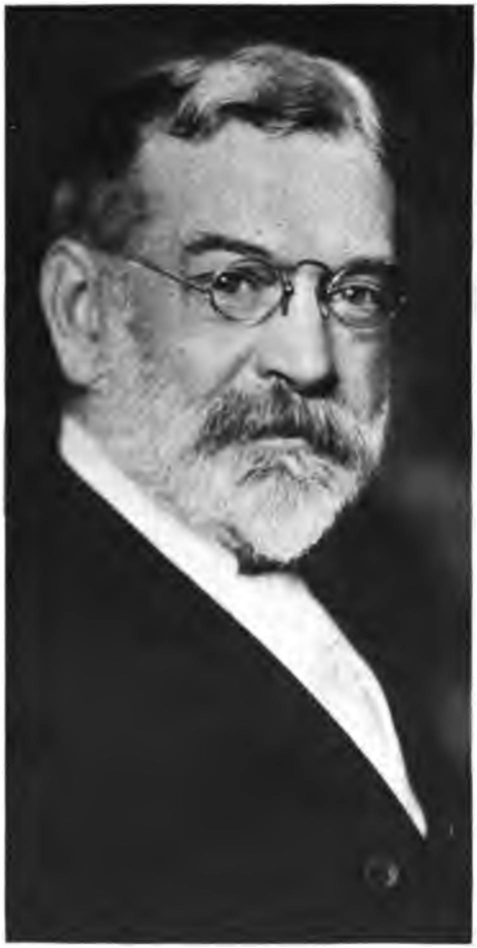
hearty; on the islands of the Atlantic from the Maine coast down to Florida myriads of milliner-proof plumage bearers are taking comfort from life. And this has all come to pass within the past two years, for it has been only about twenty-four months since the President of the Audubon Society persuaded the President of the United States that the question of bird preservation was national and that the birds could not maintain a fight against the feather hunters unless lands were set aside whereon they could live unmolested.

The first reserves in the Pacific where the slaughter of the gulls and grebes, mangasers and albatross was heavy are now fairly crowded with birds. Among the early reserves there named were the Quillayute Needle Reserve, which is a collection of desolate rocks off the Washington coast. It embraces Hand Rock, Carroll Islets, Bold Island, Jagged Islet, Cake Rock, James Island, Huntington Rock, Rounded Islet, Alexander Island, Perkins Reef, North Rock, Middle Rock, Abbey Island, South Rock and the Quillayute Needles.



William Dutcher. President of the National Association of Audubon Societies.

Agriculture is out of the question in a section of Federal property consisting of rocky islets sticking their points from the Pacific, but on those desolate wastes thousands of birds now fairly crowd each other for wing and nest room. The Flattery Rock Reservation, also on the Washington coast, was brought into executive existence on October 23, 1907—the same week as the Quillayute Needle Reserve, and it embraces the unsurveyed and unreserved islands off the Washington coast commonly known as Spike Rock, Father and Son, Bodiel-teh Islets, Flattery Rocks, Ozette Island and White Rock. On the same day the President signed his name to still another executive order setting aside what is called the Capalis Rock Reservation, which also lies off the coast of Washington. This reserve embraces Arch Island, Sea Lion Rock, Willoughby Rock, Split Rocks, Sonora Reef, Greenville Arch and Copalis Rock.

It was a quick move from the Atlantic to the Pacific, for the bird reserve plan was a new one at that time and the President had excited considerable comment but two months before by shutting out from favorite shooting grounds the Eastern sportsmen who had been slaughtering birds in Florida. His first reservation was formed there on August 8, 1907, when he signed the order making the Tern Islands Reservation a breeding ground and a national preserve. This reserve embraced a large number of small islands in or near the mouth of the Mississippi commonly called "mud lumps," but embracing thousands of acres of mud and marsh land and being for ages the nesting places of thousands

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BLACK SKIMMERS SOARING OVER BATTLEDORE ISLAND. LOUISIANA.

of ducks and royal terns. The Shell Keys Reserve in the Gulf of Mexico was signed for a week later, and a few months later protection was given to other birds which made their homes on the small mangrove and salt grass islets, shoals and sandbars in Mosquito Inlet at the mouths of Halifax and Hillsboro rivers in Florida.

At the present time these various national reserves are at Duck Lake, off the coast of Maine; whereon eider and less valuable ducks are breeding; Stump Lake in North Dakota, wherein ducks and cormorants are swarming; Huron Island in Lake Huron; Pelican Island in Indian River, Florida, where there are thousands of brown pelicans; Passage and Indian keys in the Tampa Bay; Breton Island, off the Louisiana coast, which was formerly a famous duck slaughtering ground for Northern tourists; the Shell Key Reserve, off the Louisiana coast; Tern Island, before referred to; Three Arch Rocks, off the Coast of Oregon; the Key West Reservation, off the Coast of Florida; the Tortugas Keys Reservation, embracing the islands within the Dry Tortugas in the Gulf of Mexico, and six others but recently organized. Among these are the Klamath Lake Reserve, the Matlacha Pass Reservation in Florida; the Palma Sola Reservation, which embraces an island in Palma Sola Bay in Florida; the Pine Island Reservation, near the northern end of Pine Island Sound on the west coast of Florida; the Chase Lake Reservation in Northern Dakota, and the Lake Malheur Reservation in Oregon; this and the Lake Klamath Reserve being the two largest ever set aside and embracing in land, water and marsh territory about 615,680 acres, or 942 square miles.

If the National Association of Audubon soci-

NODDIES AT REST IN A PROTECTED COLONY ON THE DRY TORTUGAS.

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HERRING GULLS—GREAT DUCK ISLAND RESERVATION. OFF THE MAINE COAST.

eties, working with the Federal Government through this far reaching plan saves merely the pelicans, the terns, the gulls and the cormorants it will have earned the thanks of the nation, for those birds are of real value as shore scavengers and there is grave possibility of pestilence overtaking many communities were they to disappear.

But if it saves the eider ducks it will have earned the thanks of all comfort lovers, for the eider duck makes the best comforter on a wintry night that has yet been discovered. He was nearly gone when the reserve plan was adopted. On No Man's Land off the coast of Maine the members of the Audubon Society had found a little colony of nine, and that small number they still believe to have represented the surviving members of the eider duck family in this country. Down hunters have been barred from that island, however, for two years, and at a count made ten months ago over a thousand ducks were found.

The terns and the pelicans were having a hard time to keep their names on the lists of "Among Those Present," for hunters were constantly leaving Pelican and Battledore islands and the Mosquito Inlet in the Southern Atlantic and the Mississippi Delta, laden with feathers and wings, but the birds have since increased vastly in those places, and on one island the black skimmers have not only multiplied a score of times but have become so tame that Warden William Sprinkle sits on the shore among them while they walk up and peck corn from his hands and cluster on his shoulders, at times. An accompanying picture showing Sprinkle among hundreds of these formerly wild sea birds proves that they have no inherent fear of man but that fear is engendered only when they realize that man comes on slaughter bent.

While the killing has not been entirely stopped the fight for the birds has made great progress. The reserves cover much territory and it is impossible for the association to properly patrol them because of a lack of funds. The nation appoints one warden for each reservation, paying him the munificent salary of $1 a month. He must look for the balance of his income to the National Association of Audubon societies. There are in the association but 1,000 members, each paying annual fees of $5, and with that meager amount all of this meritorious work must be carried forward and all of the expenses paid.

THE RARE SNOWY HERON. ITS BEAUTIFUL PLUMES ARE SO EAGERLY SOUGHT BY FASHION THAT THE BIRD IS DOOMED TO EXTINCTION.

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With an ample income to properly patrol these great reserves the work of preserving the birds would be vastly better done and the onward march of the plume hunters would be stopped. What work has been so far done has been well done, as milliners well know, for they have been put to greater trouble annually to secure the wings and the plumes that their customers so feverishly cry out for.

THREE ARCH ROCK RESERVATION.
A government reserve off the Oregon coast recently established by special proclamation of the President, for the protection of sea-birds.

What the actual practical results have been no man can say—how many birds are actually within these preserves it is impossible to tell, but it is known that since the Federal Government spread the protecting folds of the starry banner over the threatened wings and doomed breasts of the breathing hat ornaments, a number of species have been saved from entire extinction while others have increased ten fold. It is a certainty that the birds numbered some scores of thousands when the task of saving them was taken up and that they now number some millions; while for the purpose of exciting millinery wrath the statement is here set down that at prevailing plumage prices the feathers these myriads wear would appraise at $50,000,000.

Of that much at least has fashion been bereft simply because a thousand bird lovers persuaded President Roosevelt to co-operate with them in checking a ruthless waste that was little less unwise than the wastes of forests or mines and well nigh as cruel as was the massacre of St. Bartholomew's.

It's axiomatic in police circles to "look for the woman in the case" when a seemingly unsolvable mystery has "turned up" a male prisoner. In police beliefs woman is the root of all evil, and if anybody doubts the truth of that ungallant belief let him but ask a member of the National Association of Audubon societies why a thousand men were forced to band together and appeal to the executive head of the nation for assistance in preventing bird murder.

"Woman! That's the answer," he will reply.

Woman and woman's vanity. Woman's desire to surmount her head with wings, heads and breasts of birds; to swath her neck with boas made of feathers.

Verily they are all feather-mad, and as everybody realizes the hypnotic power of Paris fashions it has long since been found useless to beg them to cease wearing feathers on the score that it argued the possession of a cruel disposition. Cruelty when balanced against Fashion doesn't have weight in the feminine mind.

LAUGHING GULLS—AMONG THE MOST COMMON AND BEST-KNOWN VARIETIES OF THE GULL FAMILY.

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She who would turn pale at sight of a cut finger, will deck herself in furs and feathers that it would require a fair sized zoological park and a huge aviary to supply, and then calmly march to church to listen to a sermon against cruelty.

On her hat may be the aigret torn from the bleeding breast of a nesting mother heron, or flamingo, the head of a bobolink, the breast of a gull; the wing of a ptarmigan. And thus clad in bird scalps she worships, when in her heart there is the same pride in personal appearance as lurks in the heart of a young Apache buck wearing at his belt the first dripping scalp he has ever taken.

Louisiana Heron at Rest.

Over twenty years ago the man responsible more than any other for this battle for the birds—Dr. Bird Grinnell, of *Forest and Stream,* learned that arguments against wearing bird feathers fell on deaf ears when they were made to women of Fashion. He thundered from lecture platforms and argued through his editorial columns, but he soon had it forced upon him that unless a concerted action was taken the birds were doomed.

He organized the first Audubon Society ever formed in this country, and the fight that was made back in the late eighties did much good. In fact the battle was nearly won. Women had to a considerable extent taken to wearing flowers and ribbons and the birds were increasing in numbers. Then the membership dropped away and the interest in the movement waned.

That was the signal for Fashion to issue another decree in favor of feathers and bird slaughter was renewed on a truly gigantic scale. Women had gone featherless for seasons and they indulged in a veritable riot of plumes, wings and breasts when Paris gave the signal.

Plumage hunters went out in battalions to get the longed-for hat decorations and every section of the globe where birds congregated was invaded. The birds had multiplied; the hunting was good and the prices were high.

When American and English women began wearing the wings of ptarmigans one order from a London importer who had a branch house in New York resulted in the shipping of *twenty-one tons of ptarmigan wings* from Russia.

In this country the aigret-bearing heron and flamingo were pursued to their death or disappearance. The aigret which forms a lovely ornament, sprouts from the breast of the mother bird when she is nesting and at no other time. She is therefore easy to catch as she will not leave her eggs or her young. The ruthless aigret hunters in the rush to make big quick gains invaded the swamps of Florida and Louisiana in the nesting season, and not even wasting time to kill the mother bird ruthlessly tore the aigret from her bleeding breast and threw her aside to die. The young died with her from starvation.

These birds have been driven across the Isthmus of Panama to far off Honduras in South America, where aigret hunters are still tearing them to pieces.

The beauty of the tiny wood duck marked him for Fashion's prey. He suffered vast diminution in his ranks before the Federal protective move was inaugurated and there are but comparatively few left in the United States today. The royal tern, the red breasted mangaser, the heron, the flamingo, the skimmer, the gull, the pelican; every species of bird in fact that possesses a breast of especial sheeny down or a wing of graceful cut was marked for slaughter. That some have been saved is subject for a general congratulation; that all would have disappeared in ten years more had it not been for the National Association of Audubon societies backed by Theodore the Bird Preserver is a certainty.

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THE WATERS UNDER THE EARTH

By ANNE HARD

ONE night a Professor of Mathematics was at work in his little study looking over the lake at the University of Wisconsin. He was a theorist, whose main interest in life was the speculation as to what a particular sort of curve will do if it ever encounters another particular sort of curve on a dark night somewhere just this side of infinity.

And his name, not unknown among other such theorists, was Charles Sumner Slichter.

To him, thus studying the manners and customs of irrational curves came another professor, from the Agricultural department of the same university, one C. I. King. He, too, had his hobby and it was the study of academic particles of soil under the influence of academic particles of water. What King wanted to know from Slichter was the precise mathematical formula for determining how much water would reach the acre of potatoes in the northwest forty, when one inch of rain fell on the five hundred acres just north of your farm; and similar problems.

The first thing a bona fide, anti-Barrios theorist does when he is given a new problem, is to find out what the Germans have done. Slichter looked up what the Germans had done and he was very much pained to find that they had done very little. He couldn't even agree with their estimate of the amount of water there

A HOME OF THE GARDEN CITY PROJECT, KANSAS.
Here water for irrigation comes neither from rivers nor the snows of mountains, but is brought up directly out of the earth itself.

was under the earth, in the first place. He corrected that amount until he brought it around to a neat 565,000,000,000,000 cubic yards—one-third the volume of all the waters in all the oceans on the surface of the earth.

But that was merely a spin up a side lane. The real road he was following led to an introduction and possible acquaintance with those millions of millions of cubic yards of water that had been hiding themselves in places like California, and Kansas, and Colorado, and

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A PATCH OF MAGNIFICENT CANTALOUPES AT DEERFIELD, KANSAS.

Arizona, so successfully from the sight of man.

Of course he did not know it himself at that time. He did not guess it at all, any more than he guessed that a few years would find him making the plans for a $350,000 pumping station, which would catch and harness 60,000,000 gallons of those waters in one day in one place alone, like Garden City, or that he would be assisting cities with more drinkers than drink, like Brooklyn, to overtake other millions of gallons that were running away underground to the sea.

All that he saw before him at that time was a perfectly beautiful theoretical excursion,—namely the study of ideal motion,—abstract, unimpeded motion;—like the motion of heat; pure force—but complicated by problems in the influences of other forces. The plotted "curves" of that ideal underground liquid in the presence of other underground and overground ideal forces, look exactly like a snap-shot of three or four tons of fireworks exploding in mid-air.

Here he found the Germans sadly inadequate, and as for America,—when he looked to see what studies of this kind had been made of underground waters in America he found the total results amounted to just exactly nothing. No measurements of underground waters had ever been made in the United States.

And then there rose before his mind's eye the wide stretch of Western fertile, arid country, needing only water to develop it. He saw thousands of dollars' worth of expensive machinery rusting, miles of ditches meant to carry water carrying only buffalo grass and sage.

He saw Western Kansas as it was after the migration of the early 'eighties, a grave-yard of hopes, where settlers who had been beaten in the battle with drought had moved away, leaving the high plains more desolate than before their coming.

These settlers had heard of prairies—what they found was unrelieved flatness covered with the coarse stems of buffalo grass and sage brush, scored with arroyos—dried scabby scars of reddish yellow. They had seen on the maps the lines marked "Arkansas River," with little branches running out in all directions that spoke to dwellers in the moist

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world of the reedy creeks where black birds sing, at home.

They found a long sandy line cut groove-wise in a high cliff, like a scratch on a withered arm. It was a strange, almost malignant contradiction of everything they had ever heard about rivers,—this "Arkansas,"—which reversed the usual rule of rivers by proceeding along a height, which turned toward every point of the compass in its course and which when it was most needed, refused to flow at all and lost itself under its sandy bed or else rushed by in a torrent and mockingly filliped their need with its waters when, at rare intervals, the storms in the mountains to the west hurried the spring rains and the melting snows into its bed. For then it seemed to be protected by a sort of mucilage which prevented the waters from sinking into the very soil they overflowed.

One by one the settlers gave up in the fight for which they were so ill prepared. At first one by one,—but then suddenly their flight became a stampede. The country was depopulated more rapidly than it had been settled. They went, and in their going took everything with them, even to the walls of the houses. Only the scattered foundations were left, or an occasional church or school house, which, being of brick, was not of future use to them for kindling fires.

Slichter thought of all that melancholy scene, of all the wasted effort of recent years in the settlers' fight for water.

Something happened to the theorist at just precisely that point. He got suddenly transformed into the living imitation of a man of action. The next thing he knew, the long coat and derby were left behind, and the professor found himself in brown corduroys riding up the dry bed of the Arkansas River in Western Kansas. He was in an open buggy and a cow-boy was driving.

His one link with his past was in his pocket. It was a slip of paper, elaborately hieroglyphed with equations, which were the theoretical answers of Professor Slichter to the hypothetical questions of Professor King.

One glance at the lay of the land convinced him that he had come to the right place at which to put his theories to the

A SUBDIVISION OF THE MAIN CANAL OF THE GARDEN CITY PROJECT.
Created by pumping water from underground.

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THE DESERT BLOOMS WHERE THE LATEST FORM OF IRRIGATION IS APPLIED.
Sugar beet field estimated to average over twenty per cent saccharine.

test. The Arkansas River at this point in Kansas deflects in its North and South flow and ambles off in a general easterly direction, when it ambles at all. As a matter of fact, when a settler comes around looking for it to do a little work for him, he finds a few miles of dry gully and the unresponsive sand hills confronting him. They were confronting Slichter as he drove up that day in August looking for a chance to try his equation on a recalcitrant stream. That river bed was so hard and dry it would have delighted the soul of a good-roads expert. To the north of him as he drove westward in the river, he looked upon a flat region high enough to be called "Uplands." To the south of him were the great sand hills.

There was water in the stream a part of the year,—a whole flood of it. It was thought that that same flood was now under the surface. But the people who had tried to recover it had left the wreck of their practical experiments behind them in the shape of abandoned ditches the very biggest of which, called "Farmers' Ditch," led off in melancholy mockery of the water it hadn't carried for fifteen years toward the Uplands north of the river, near Garden.

The Uplands had a few farmers who had recovered some acreage by means of wells. But there was not much of it because, for one thing, people were afraid. Most of them believed in the presence of a body of water under their land, but they had had very different experiences in getting it up. One man would sink a well a hundred feet without getting water. Another would strike it at fifty. In August of 1896 a well three-quarters of a mile south of Atwater, in Meade Co., had gone down 288 feet through blue clay, while other wells a mile or two away had struck water bearing sand in 20 to 40 feet. The various stories various men had to tell had led to some difference of opinion about what this world of water was, which was strangely enough

THE POWER STATION AT GARDEN CITY WHICH FORMS PART OF THE $350.000 PLANT THAT PUMPS THE WATER.

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only a few feet away from a waterless world, too.

Slichter was going to find the answer to the question. But in order to find out about the water, he first began by trying to find out all about the sand. In other words, he began by studying not the water itself but the material which contained it. This was not the mere mathematical jag it may seem at first sight. These underground rivers which he wished to study are not the "cavern bound waters of night" the poet sings about, but the "seepage waters" the plainsmen are still guessing about, the courts just beginning to wrangle about and the economists to figure into their systems.

They are not bodies of water held as in a tank or reservoir under the earth, like a lake, nor even free moving streams, like a surface river. They are simply *moisture* which saturates certain underground regions and which moves along through those regions somewhat in the same way that water reaches the other end of a blanket when one end is wet. Only, that numberless outside causes help to squeeze this sponge-full of water, such as gravity and differences of barometric pressure and the tides—or even a thing so unthought of as the passing of a railroad train.

The water under each man's land is not merely that which has rained or melted upon it and so sunk down like loose change thrust into his trousers' pocket. Getting it up again is not a simple matter of digging—like pulling out a nickel for car-fare.

Those great areas of water have their perfectly definite motions as regular and as lawful as the flow of any other stream.

What are the laws of that flow? The answer may keep a theorist busy for many happy years. But it will also help to give many a city an adequate water supply; it will save yet uncounted hundreds of settlers in the arid regions from wasting their money on impossible recovery projects.

A RESIDENCE STREET IN GARDEN CITY. IN THE HEART OF THE NEW IRRIGATION AREA.

It has done so already. But Slichter didn't think of all that—*then.*

He simply dug up a handful of soil in various places and went back to Madison. There for the first time those age-old grains of sand were seized by the throat and told to give up their secret. They were measured in millimeters, dry and singly. They were weighed and magnified and photographed, posed as billiard balls in a trigonometric tableau.

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But most of all, their behavior was watched when they were introduced to water.

In this way Slichter found that the ability of a soil to let water flow through it depends not only upon the size of the individual grains that compose it, but also upon the way in which they are packed. And he was able to compose a table of figures, from which, if one measures the size and finds the average for the sand in a certain region, one can make an accurate guess at how much water can possibly flow underground through that region.

When he had found out everything about the soil which contained the water, Slichter went back to Kansas again. From his knowledge of geology he could tell in a general way the lines of position of the sheet of underground water. He could see from sink-holes or from disappearing streams the probable hiding place of waters which had left the surface. But his study of the difference in the way that various soils transmit water was the most accurate guide in picking out the region where the most water had sunk down through the earth to join the great, ever-absorbing stream that was somewhere underground.

For it seemed that the water of greatest practical value was not that of streams which had got tired of fighting the heat in a region where an evaporation of 90 inches was common, streams that took a rest by crawling under their bed. They helped. But the really important water was that which had percolated downward directly through the soil and had gathered together and united into the real aristocracy of underground waters *after it had got beneath the surface* of the earth, and was moving along, fast or slow, but inevitably, toward the sea. The water that was recovered in Kansas might have seeped down under the soil in Wyoming six months ago, or it might have rained upon the sand-hills last week. Only the study of special conditions could determine which.

He began to sink experimental wells in the bed of the Arkansas, and north and south of the river. He used the wells already there, about 75 of them,—and he sank nearly two hundred more.

And he made the extraordinary discov-

THE MAIN CANAL AS IT APPEARED COMPLETED AND STILL FREE FROM WATER.

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ery that while the waters of the Arkansas had disappeared and were moving along underground, none of the wells back a very little north and south of the river were fed from those waters, but all got their supply from the rainfall upon the hills and plains themselves—those arid hills and plains that the settler had fought so long.

His experiments and his observations had now shown him with considerable accuracy *where* to look for water. But they had not given him a line on *how much* water to expect to find. If a man came to him and asked him where to dig for water, he could with very little trouble make a good guess as to the best location for a well. But as to the *capacity* of that well and the rate of the engines and the amount of money the man would be justified in expending—that he could not tell. One step more was needed before he would be in a position to form a judgment. And yet those were precisely the essential points for the man who was raising water in order to raise crops and who must make close figures in order to compete with the man who didn't have to raise water in order to raise crops.

It was then that the theoretical equation and the theoretical interest of the theoretical man rose up and gloried. He had been attracted to the whole underground water question in the first place by the mere little point of wondering how fast those waters *could* move in their infinitely small capillary pores. Now if he could accurately determine how fast they *do* move of course he could come very close indeed to estimating how fast the water would take the place of air in a suction pipe at any one spot. In other words he could *predict the amount* of water which could be pumped at any one point.

For, remember, he was not telling people to run pipes down into a reservoir, but, as it were, into a moving succession of infinitely small drops.

If those drops were moving very slowly and you were to withdraw one of them, it would be so long before its place could be taken by another that the pump could not possibly be kept busy. On the other hand, if they were moving very rapidly, as soon as one drop was removed there would be another there to take its place.

So Slichter devised the first accurate, scientific method for measuring the "rate" of that motion, which was also so practical that it can be used from now on forevermore whenever anyone wishes

THE MULE FARM, GARDEN CITY, WHERE OVER SEVEN HUNDRED MULES FIND PASTURAGE.

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THE HARVEST—A RICH CROP OF ALFALFA.

to know how much water he can absolutely count on at any one spot.

What he did was to go out into the arid empty plains of Kansas, near Dodge, and out into the dried up bed of the Arkansas, and there dig three wells, across the stream, measure a hundred yards further down, and dig three more wells. Then he rigged up a simple electrical device. That is, he put salammoniac into the up-stream wells and tied the down-stream wells to the up-stream wells by some pieces of copper wire, in circuit with a battery and an ammeter. The salammoniac turned the water underground into an electrolytic conductor of electricity. When the current of electricity finally reached his second row of wells, he knew that the same water which had started out from the first row of wells had now reached the second. By dividing the distance between his two rows of wells by the time it took the water to flow between, he could measure absolutely the rate of flow of those runaway underground waters.

This apparatus showed the progress of the water. But readings had to be taken regularly. He found it rather tedious—after a while—to sit up all night taking observations. So he added to the underflow-meter a self-recording clock in place of the direct-reading ammeter. After he had made a few changes in the apparatus such that it could be readily carried about and could live happy and do its work in an old box a hundred miles from anywhere, he went down to Denver. Mr. F. H. Newell, chief engineer for the Government Geological Survey, happened to be there. When he heard the results of Slichter's experiments, he began to take notice.

Slichter told Mr. Newell that the average current near Garden was eight feet per day, although there were many places where the velocity was as high as 22.9 feet per day. He said that the strip necessary to recover 100 second-feet, or 100,000,000 gallons, per day for 150 days in the year, must be 24,000 feet wide and 300 feet deep. Such an area of the right sort of gravel existed about Garden. He called attention to the existence of abandoned ditches, especially the well-known "Farmers' Ditch" which could be used if a large recovery plant were built.

That same "Farmers' Ditch," which was then sand-choked, is now conveying water at the rate of 60,000,000 gallons a day up to more than 10,000 acres of sugar beets and fruit farms. But the water is not pumped out of wells where the chance guess of the man with a shovel had looked for it.

It is recovered 'way *south* of the river, siphoned under the river, carried through the "Ditch," through a concrete-lined flume, over a mile, to be tapped off by innumerable little ditches wherever it is needed.

Twenty-three wells suck the water in

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STACKING ALFALFA.

from those underground regions. All of which is necessary because wells *north* of the river can not practicably reach a sufficient supply.

And it is all happening there every day now in exactly the region where private wells had been abandoned and irrigation works given up because the underground water supply seemed to be too slight.

There is a flourishing town, a line of electric cars to connect that town with a string of others, a $15,000,000 corporation organized to provide electrical power, all kinds of capital, all kinds of prosperity, sprung up, made possible, because a certain "theorist" started out to verify his equation.

Then the city of Brooklyn, which had been worrying along for years on a totally inadequate water supply, decided it could stand it no longer. Brooklyn in 1860 had an annual consumption of water of 3,293,000 gallons. In 1895 it was consuming 75,735,000 gallons,—and trying to do it on the same old supply it had had in 1860. It needed one hundred million gallons more a day in order to be prepared for the future. Its efforts to get that hundred-million-gallons were pitiful. First it wanted to go over into Nassau County to get it. But the courts wouldn't

THE APPLE ORCHARDS ARE BEAUTY SPOTS IN THE ERSTWHILE DESERT REGION.

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let it do that. So it found itself between the Sound and the Sea and the Courts and was on the point of throwing up its hands—when it decided to thrust them down instead.

A commission became very busy, and Slichter was pulled away from the accurate measurement of specimen grains of sand he had been collecting in the West, and set to studying the little runaway streams under the surface of Long Island, to see whether they were worth harnessing to the Brooklyn pumps or not.

He went up and down the Island with his equation, tried it on all the flowing water he could find under ground, and found there was enough there to keep Brooklyn supplied for many years to come.

Millions of gallons were there to be pumped, in the very region and at the very time when ordinary observers, even those interested in the problem, could exclaim, like the Brooklyn Commissioner of Works in his annual report: "There may be water—but it is of probably no very great magnitude."

However, Slichter wasn't in the East very long. His real job was in the West. While he was putting down his own little experimental wells in California and Kansas and Colorado and Oklahoma, he was studying every well of every man, woman and corporation he could find. It wasn't long before he was advising people to go slow, to be careful; not long before he was reminding people that even water, necessary as it is, vast as it is, is not unlimited.

At Dodge, Kan., for example, over $100,000 was wasted on one project. At Cherry Creek, Col., the Denver Union Water Co. spent $200,000 and got about 50,000 gallons of water a day.

A GENERAL VIEW OF THE IRRIGATED REGION NEAR GARDEN CITY.
The farm buildings suggest prosperity and enterprise.

Slichter was now in a position to help people against mistakes of that kind. He found himself in California working on those problems. To the people he told to go ahead and dig he added the people he told to save their drills and their money. Sometimes he would tell a man to abandon a well and dig another at some other point. Sometimes he would show by his test wells that the water was there, but that the man was failing to recover because his pump leaked or because it was not the right sort of pump.

The room in University Hall at the University of Wisconsin where the pro-

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fessor had been wont to consult with students now is choked with blue-prints and plans of projects concerning which he has been asked for advice.

But it is all going to be cleaned out pretty soon.

For a real theorist is incorrigible. He turns his back on the tangible results. He goes back to his world of ideas.

No more location of possible stations, no concrete pictures of brick and steel for him. After this year, he says with a smile of anticipation, he is going to devote himself to some real work. It will concern underground waters, too.

What will it be?

It will be the study of the curves on the surface of those underground streams. Theoretical curves on academic waves of ideal streams.

NEW BLOW AT THE WHITE PLAGUE

By FREDERIC BLOUNT WARREN

Frederic Blount Warren, author of the accompanying article on tuberculosis, is, at present, one of the editors of a Philadelphia newspaper. For a number of years he has been a special writer for papers and magazines in the larger American cities, and has traveled extensively. Several of his articles have appeared in the Technical World Magazine, and under his own and other names he contributes regularly to many of the better class magazines. He has taken much interest in scientific progress. His specialties are technology and popular science, and he has devoted much time to a study of surgical progress, disease-fighting methods and sociology. His work is too well known to readers of this magazine to need further review.

First publication of what promises to be one of the greatest of recent discoveries in the campaign of disease-prevention is made herewith in an authoritative article on proving the presence of the tuberculosis germ in the blood and the positive determination of what hitherto has been largely a theory: that the blood acts as a conveyor of tuberculosis germs from one organism of the body to another. The photographs accompanying this article are the first to be published anywhere and were made expressly for the Technical World Magazine by Frederic Blount Warren for inclusion in his text.

SINCE KOCH, of Germany, discovered the tubercle bacillus, or germ, it is extremely doubtful whether there has been a successful research of greater moment to the disease-fighting scientist and the public at large than that just announced in Philadelphia.

This discovery is the proving in many cases—not four or six, but fifty or sixty—the presence of the tuberculosis germ in the blood of a human being and in establishing beyond all doubt that human blood acts as a conveyor of the consumption germ from one organism of the body to another.

All of the tests and the final demonstration of what had been largely a theory are the work of Dr. Randle C. Rosenberger, bacteriologist of the Philadelphia General Hospital and also bacteriologist of the Jefferson Medical College, either of which positions is a mark of distinction in Philadelphia.

There is an unusual feature of the technique of this scientific discovery, in that its simplicity may be likened to a child's primer and that, stated in what the lay public considers scientific jargon, it is quite as understandable, just as easy for the mental digestion as the simple, every-day human stories we are furnished each morning or afternoon in our favorite family journal. For the moment this simplicity is apt to make one question its importance, because it fails to astound or puzzle us, but an effort will be made to show the relationship of this consumption-detecting agency to a dollars-and-cents, itemized bill that we of the nation have to pay for the ravages of tuberculosis. By that means, beyond all others,

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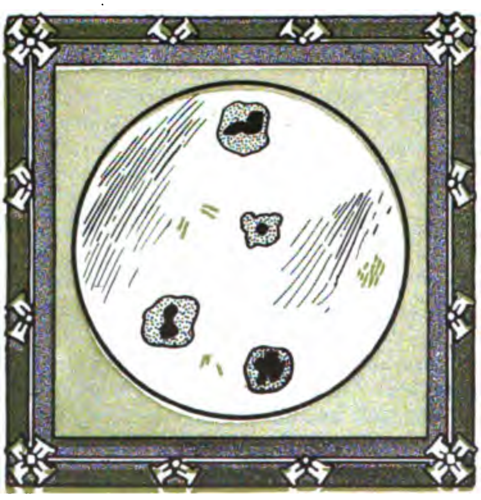
STEPS IN THE PROCESS OF SETTING BLOOD ON MICROSCOPIC SLIDES.
Nos. 1 and 2—Blood dried on the slide; No. 3—Slide after "laking"; Nos. 4 and 5—Slides finally stained and ready for examination.

the question of values can be approximated most convincingly.

The general interest in tuberculosis which has been apparent in all sections of the country within the last year or so has stimulated many investigators to try and find out the whole truth, if possible, concerning the tubercle bacillus and its cause.

Primarily it was this interest that caused Dr. Rosenberger to begin his series of experiments and investigations with the purpose of ascertaining just how the bacillus is eliminated from the system and its mode of traveling from one part of the body to another. It has long been established that the tuberculosis bacilli are present in the sputum and the urine, and last year Dr. Rosenberger was able to demonstrate them in fecal material, thus proving them present in the last large avenue of elimination.

The problem that has long been puzzling scientists in this particular field has been the mode of transmission of the organism, say, from the lungs to the intestines, from the lungs to other internal organs, or vice versa. Naturally the blood has been considered the possible carrier but no one to the present time has been able to demonstrate the organisms in the blood by simple methods. It has been taught and believed for years, and especially during the last few years, that tuberculosis was not hereditary but that the person so affected was first so lowered in body resistance, from various causes, that he was a fit subject for the



A Drop of Blood. Greatly Magnified.
This was taken from a patient afflicted with tuberculosis. The little lines in green indicate location and presence of the germs.

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HEATING SLIDES ON A COPPER PLATE.

disease and in this condition acquired it from some outside source, such as the sputum of another person, through milk or food, and even other means of contact with germ-infected articles or persons.

While many and perhaps the greater portion of tubercular patients do acquire it from some outside source, in a certain percentage the disease is hereditary, as partially proved by the finding of the tuberculosis germs in the blood of fifty patients under examination in the Philadelphia General Hospital.

With the exception of one or two, the fifty cases reported were cases of known tubercular lesions in the body. The find-

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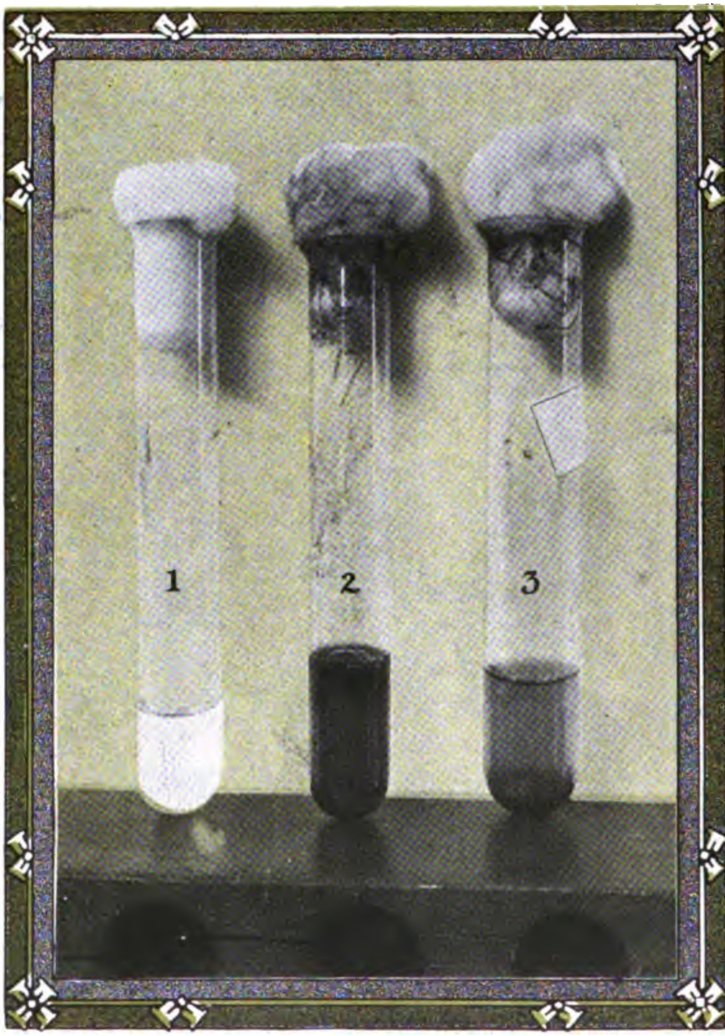
ing of the germ in the blood of these cases, and many more probably to be found in the future, has straightened out many perplexing problems. It is the "missing link," as it were, in the chain cycle of the disease and the one thing which will, without doubt, give scientists a definite basis, or groundwork, upon which they can base their future efforts to stamp out a disease which, in some form, attacks about sixty per cent of the population of the United States. It will stimulate many co-workers to further efforts in the hope, since to science nothing now seems utterly impossible, of finding that "something" which will check, hold and vanquish the bacillus causing all the damage.

Despite the simplicity of the method of obtaining and examining the blood for the tuberculosis germ it must be carried out very carefully to obtain results. The organisms do not come to the scientist or parade across the slide inserted in his microscope, but must be sought for and found after the exercise of infinite pa-



STEPS IN THE BLOOD TEST FOR TUBERCULOSIS.
Vial No. 1—Normal salt solution; No. 2—Fresh blood; No. 3—Blood after standing twenty-four hours.

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INOCULATING GUINEA PIGS WITH THE TUBERCULOSIS GERM.
The study of the development of the disease in the blood is greatly aided by the use of these little animals.

tience. After the blood is ready for examination the germ must often be sought for an hour or more and, again, four or five cases may be found in the same length of time. Thus far in Dr. Rosenberger's examinations the number of organisms found do not seem to bear any relation towards the severity of the disease. In far-advanced cases only a few may be found, while in initial-stage cases many may be seen. Dr. Robert Keilty, who has assisted Dr. Rosenberger in nearly all of his investigations, summarized the actual method for me in about these terms:

About the arm of the patient to be examined a tight tourniquet is applied in order to bring the veins into prominence. One vein of sufficient size is selected at the elbow and the skin over this is sterilized chemically to remove any possible infection or contamination from the skin itself. A syringe on the principle of a hyperdermic, only larger, which has been previously sterilized by boiling, is used to obtain the blood from the patient.

The needle is thrust directly into the vein and 5 cubic centimeters—two teaspoonfuls—of blood withdrawn. This blood is immediately mixed with a solution in a test tube to prevent its clotting. This consists of normal salt solution, a substance most nearly conforming to the elements of the blood, with two per cent citrate of soda in it. The wound in the arm, which is only the size of the needle-prick, is covered with a suitable dressing and the tourniquet is removed. In nine out of ten cases there is no inconvenience to the patient beyond the tingling sensation of having the blood current cut off.

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Instead of trying to cultivate this solution of blood, as is done, for instance, in obtaining the typhoid bacillus from the blood, it is put on ice for twenty-four hours. At the end of this time a sediment has collected in the bottom of the tube and by means of a pipette—a hollow glass tube—this sediment is drawn up and spread evenly on a small glass slide. Laid on a copper strip above a small even flame the strip is thoroughly dried until the blood substance has become as hard as leather. The red corpuscles are next removed by immersing the slide in distilled water. This process is called "laking." Then the slide is thoroughly dried again and is ready for "staining." In order to demonstrate the presence of the tuberculosis organism the known rule of "staining" must be followed. While there are several methods, that practiced by the Philadelphia General Hospital is as follows:

The slide is immersed in carbol fuchsin, a red stain, for five minutes; in Pappenheim's solution, a blue stain, for five minutes. The first stains everything red and the second takes all the red out of everything and stains it blue, except the tuberculosis germ. This remains red and the scientist is thus enabled to find it. The stained and dried slide is then examined under a microscope which will magnify the bacilli 1,200 times. The

MAKING PREPARATIONS FOR STAINING THE MICROSCOPIC SLIDES WITH BLOOD.

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entire slide must be examined until the organism is found. In some cases it is abundantly present; in others it will show only one or two and these only after exhaustive search.

But if a single swallow does not make a summer, the presence of one consumption germ in the blood surely does indicate tuberculosis somewhere else, whether it be in the lungs, other internal organs or in the bones or joints. The method, stated in detail, may look difficult, but in its simplicity the physician may do it at any time and clear up, in his own mind, doubtful cases.

What this will mean in the early cases, the diagnosis of which may be obscure before the patients have lesions enough on which to make a diagnosis, may only be guessed at, but it entails no strain for even the lay mind to make this guess. It is just such cases, when taken early before they have had the disease long enough to produce tissue changes, that by proper treatment may be benefited and in most cases cured as far as any further progression of the disease is concerned.

Again, the presence of the tuberculosis germ in the blood will lead physicians to understand why many cases spoken of as typhoid-pneumonia, typhoid "states," —conditions—etc., are in reality initial-stage tuberculosis and, being recognized, they will be treated as such.

In the matter of heredity there is no reason, if the bacilli are in the blood of the mother, why they should not be in the blood of the new-born, thus accounting in many cases for the tuberculosis in early childhood. This is not stated as conclusive proof of heredity by the writer of this article but it has started scientists on the right track to find more conclusive proofs. It is likely that Dr. Rosenberger's investigations in the immediate future will be along this line.

Among the cases studied by Dr. Rosenberger have been many of very wide interest. For example, one had been negative to the tuberculin eye-test; it was an early case and the consumption germ was found in the patient's blood.

Another man admitted to the psychophatic wards with severe mental symptoms supposed at first to be due to the toxaemia of typhoid fever revealed the tuberculosis germ in the blood test and careful examination of his chest after this proved conclusively that he had consumption. Later at a post mortem every detail of the previously-formed conclusions was borne out by the findings. There have been many other cases in which the finding of the germ in the blood fixed the diagnosis completely.

DR. RANDLE C. ROSENBERGER, WHO HAS DISCOVERED TUBERCULAR BACILLI IN THE BLOOD.
His work proves that consumption is an infection through the blood.

No work has been done by Dr. Rosenberger, as yet, on obtaining an antitoxin, but of course it is not an impossibility. The discovery of the bacillus in the blood—showing that the disease is a bacteraemia, that is, an infection through the blood—points almost conclusively to the fact that an antitoxin to cope with the disease lies hidden in the mazes of science, even though it is now unknown.

So here in lay, and almost wholly non-scientific terms, is the technique of a wonderful life-saving discovery contain-

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TAKING BLOOD FROM A PATIENT.

year and keeps 700,000 in invalidism. This first is equivalent to the total number of enlisted men in the army and navy of the United States. Estimate the average earning power of these victims at $1.25 a day. Suppose they worked 300 days a year before being stricken.

At five per cent the money thus earned represents a capital of $7,500. Multiply this by 160,000; then multiply it again by 700,000, representing the invalids. Divide the products in half to eliminate women and children and non-producers.

The result is three billion, two hundred and twenty-five million dollars. It is the loss in wages in one year from preventable disease. With it we could pay the running expenses of the government for five years. Another way of putting it is: It would pay a per capita income of about $45 during a five-year period to every man, woman and child in the United States. The saving of these victims of tuberculosis would be equivalent to the creation of three cities like Indianapolis, St. Paul and Kansas City.

Now let the reader form his own estimate from the statement of these facts and make comparisons of his own as to the value of a consumption-detecting agency that bids fair, in its development, to cut the death rate from tuberculosis perhaps in half. There will be, of course, but one answer to this important question of values.

ing absolutely no secret method jealously guarded by its scientist-parent; a discovery that any physician can apply; so plain as almost to seem not new; an accrued and definite research which will profit its originator in reputation but not in dollars other than those gained by a man's natural advances and mental progress in his own particular section of the scientific vineyard.

A quarter of a million Americans are killed every year by diseases that can be absolutely prevented. Waive the sorrow and the inhumanity of it and let us have a little class in arithmetic to ascertain what this means. Shouldn't there be a huge significance in the fact that preventable diseases kill an average of one person every two minutes? And here is consumption's share in this sweep of death:

Tuberculosis kills 160,000 persons a

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FIRE FIGHTER THAT GIVES NO QUARTER

By A. W. ROLKER

A STATIONARY fire engine sucking veritable rivers of water, now hurling these with the impact of a cataract clear to the roof of a forty-story skyscraper, now turning a deluge from sixty to a hundred and eighty streams against a burning city block, now sniffing out a conflagration which on the wings of a fifty-mile-an-hour gale threatens an entire town with destruction, and now conquering two, four or six fires that may have broken out at the same time in widely separate districts; such a device is the high pressure fire service, the wonderful new fire fighting machine which is going to revolutionize our fire fighting methods so that within five years not a fire engine will be seen within the heart of any of our first class cities.

Although at present the new system is in operation in only a single district in the Borough of Manhattan, not in a generation has an invention aroused keener world-wide interest among those entrusted with the conduct of municipal affairs. From almost every big city in the United States, from every country in Europe, even from far-off Japan engineers have gone to Manhattan to view for themselves the almost incredible performances of the new device. For aside from economic features so vital that before long they will be felt by every householder in the country, the new

A SCORE OF SUCH STREAMS WOULD BATTER AND DROWN OUT MOST FIRES.

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Exhibition of Big Streams at Coney Island.

gine system of fire fighting. In the new system not a fire engine is in evidence. Instead of so many fire engines clanging and screeching and scattering livid coals through streets on the way to fires, there are so many hose wagons—ponderous, massive affairs of extraordinary width, weighing five tons, laden with 2,000 feet of black, all-rubber hose tested to withstand the enormous pressure of 450 pounds to the square inch, drawn by teams of three - abreast horses and each fitted with a turret nozzle resembling a mounted rapid fire gun. Instead of so many grimy engineers regulating engines, a single electrician in charge of a pumping station, who may be miles away, grasps a wheel and turns his wrists and in an instant gigantic, electrically driven pumps revolve, hurling Niagaras into a special system of underground fire mains and hydrants at such terrific pressure that firemen need only to couple hoses direct to the hydrants and bombard the

system means no less than that hereafter our cities, any of which are today at the mercy of a Baltimore or a San Francisco fire, will be rendered absolutely conflagration *proof*. And so perfect is the new device in even every theoretical requirement of the ideal modern fire fighting contrivance that it is safe to say its principles will remain in use for all time to come, at least as long as water remains the chief reliance for conquering conflagrations.

Broad although these claims may appear, yet they have been officially made by New York City where the new service has done splendid execution during six months' trial in what is undoubtedly the most valuable section of Manhattan. In fact, the high pressure service has given such extraordinary satisfaction that the gradual withdrawal of fire engines from the protected district has begun while the city has appropriated $1,800,000 to extend it throughout the East Side, so congested with population that almost any sort of a big fire would entail an appalling loss of human lives.

The high pressure fire service differs somewhat in principle from the fire en-

Hydrant with High Pressure Gauges.
Control of the water's force is easy with these recording instruments as aids.

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HIGH PRESSURE LINKED WITH AUTO FIRE WAGON.

flames with deluges of water the like of which never have been seen at a fire.

The torrents which the high pressure can direct and the enormous force with which it can project these are, compared with the fire engine, almost incredible. At the maximum pressure of eighty pounds the average fire engine throws a stream of five hundred gallons a minute to a height of 100 or 110 feet—the last forty feet consisting not of a solid column of water but of a brush of spray. *Thirty-six thousand* gallons a minute the high pressure service can project in a solid column to the height of 300 feet; roughly, a hundred feet higher than the roof of a twelve-story building. And if it is not required to project the stream higher than 200 feet, *fifty thousand* gallons a minute—200 tons of water—the equivalent of the combined streams of one hundred fire engines, may be sent.

Striking although these bare figures may be, they do not begin to give an idea of the incomparably superior fighting ability of the high pressure fire service as compared with the now superannuated fire engine. One of the greatest shortcomings of the fire engine is the inability to throw what water it pumps with sufficient force. During exceedingly "hot" fires of the sort that radiate so much heat that buildings 200 or more feet outside the actual flame zone suddenly explode into fire, firemen are frequently driven back beyond the reaching distance of streams so that only by playing the stream from one engine upon the nozzlemen aiming the stream of another engine are the men enabled to approach near enough to reach the flames. Worse, at best the stream from a fire engine is a sickly, apologetic affair that tries the difficult feat of extinguishing a fire from outside inward, that breaks into spray and is converted into steam before a cupful of water reaches the flames and which at best cannot extinguish but only can hope to prevent the spread of a serious conflagration.

Again, peril of destruction confronts a city using the fire engine system every time there is a big fire that concentrates most of the "steamers" in one district.

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For a second big fire may start in a remote section, the slim reserve force of widely scattered engines left on guard being unable to pump enough water to prevent the spreading of the flames and the destruction of the entire town. And again, during snowstorms and blizzards engines are often delayed, not infrequently permitting a fire which under ordinary conditions might have meant the loss of a few hundred dollars to turn boxes, barrels and bales like pebbles in a mountain torrent and drowning the fire from inside outward by striking at the very heart of the flames.

No half dozen fires widely scattered throughout a district can terrorize the high pressure system. For no matter how much water is being drawn from the hydrants at any number of points, it stands to reason that the same volume of water which is discharging at any

THE HIGH PRESSURE BATTERING-RAM BROKE THESE WALLS IN.

into one causing a loss of so many thousand.

With the fire fighter that neither gives nor accepts quarter, there is no such humbug. It has not learned to permit a structure to be gutted by fire while it turns attention solely to saving adjoining structures. The solid column of water it hurls is a livid, infuriated cataract, a demon in itself, that leaps joyously to a distance farther than a city block, that smashes through partition walls as if they were pasteboard, hurling burning hydrant is available at instant's notice throughout the system. No matter how deep the snow, no matter how slippery the ice and how congested the streets, all remains the same to this monster fire fighter which within two minutes can send its seething rivers a distance of ten miles and which asks only for a hose wagon with a body high enough to clear snow drifts and with a team of three-abreast horses that would race through hades.

It was the Baltimore fire that gave

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TWO MEN AND A TRIPOD ARE REQUIRED TO GOVERN EACH NOZZLE.

birth to the idea of the high pressure service, for it was this that brought home to New York the realization that the present system of fighting fires failed utterly to measure up to modern requirements and that the only thing that stood between the city and a devastating conflagration was the marvelous skill of the world-famed American fireman whose efficiency lay not in his fire-fighting appliances but in his skill to nip fires in the bud before they have had time to grow serious.

Who it was that originated the idea of the high pressure system is not generally known but it was Mayor McClellan of New York who outlined it shortly after the Baltimore fire.

"Checking a conflagration is simply a matter of throwing water enough upon it," he argued. "To the east of Manhattan and to the west of Brooklyn we have the East River, to the west of Manhattan we have the Hudson. Here is water supply limitless as the ocean. Why not have this continually in reserve for emergencies? Better, why not use it altogether for fire purposes?" Then he detailed the new system which differs only in one essential from the plans as finally carried out; for, although few persons even in New York City seem aware of it, it is neither the Hudson nor the East River which the city turns on its fires. "As well burn things up as salt them down," the Board of Underwriters protested, owing to the effect of salt water on merchandise. The upshot was that the rivers are simply held in reserve for a last emergency. It is city water from the Central Park reservoir that is used and it is this fact that makes the new service of world-wide interest, for it makes it applicable not only to cities on the banks of streams but also to the most land-locked towns

Nothing is easier to understand than the principle upon which the high pressure fire system is operated. To follow it most readily, consider it as installed in Manhattan, where it now protects an area of some fifteen hundred acres, which includes twelve blocks of the wholesale dry goods district, alone valued

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STREAMS FROM THE SURFACE RIVAL THE WATER-TOWER.

between the immense sums of $300,000,-000 and $400,000,000.

On the west side of the Borough, on the banks of the Hudson at Gansevoort and West streets, and two or three miles diagonally down town on the East River front at Oliver and South streets, are the pumping stations—sturdy, compact, one-story buildings of mottled brick, plain of design and ornamentation, suggestive of the important work going on within. Inside each station, arranged three on one side and two on the other are five gigantic centrifugal pumps each connected with a 1,000 horse-power electric motor driven by a direct current of 6,600 volts—enough to kill like the snapping of fingers an army of 20,000 men. Each pump when run to the full speed of 750 revolutions a minute is able to throw 3,600 gallons of water at a pressure of 300 pounds, or 5,000 gallons at a pressure of 200 pounds to the square inch.

To supply the vast sea of water which these pumps throw, the pumps of each station are connected with a thirty-inch main running to the Central Park reservoir and, in case of emergency, with similar mains connecting the pumps with the respective rivers alongside the stations. To distribute the deluge into hydrants throughout the district and to enable either one or both of the pumping stations to force into the mains at the same time, an enormous loop of twenty-four-inch pipe girdles the entire protected district and connects with the pumps of each station, while an underground grid-iron of twelve-inch mains runs through cross streets and into the loop at either end, the pipes coming to the surface in 1,274 hydrants, each fitted to discharge at once into four lines of fire hose.

To enable the officer in charge at a fire to give orders to the men at the pumping stations 214 telephones connected by direct wire with each station are scattered throughout the district, each telephone box being so placed that no matter where a fire may be there is always a box which the chief can use without having to lose sight of the fire. And this is all the technical description there is to this egg of Columbus which for a generation men have been trying to set on end.

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Next to efficiency, the most important feature in a fire fighting device, upon the faithfulness of which the fate of thousands of human lives and the fate of millions of dollars may depend, is the invulnerability of the system, the impossibility of being crippled and put out of commission by whatsoever contingency. This, exactly, is after all the most striking feature of the high pressure system as installed in Manhattan. Just as nearly as engineering skill and human foresight can foretell, so long as water remains in the Hudson and the East rivers no conceivable accident can prevent the pumps from hurling their floods.

BEHIND THE HIGH PRESSURE GUNS.
A mob would have hard work facing this sort of a battery.

Were the Borough aflame from end to end, the stations, built of fireproof materials and located on the edge of the town where hemming in by fire is physically impossible, would stand wrapped in a continuous water curtain, flooding deluges through the pipes as long as a man was left to aim a nozzle. Were an explosion in a street to wreck the intakes of the pumps connecting the stations with the reservoir—through a widely divergent route from the reservoir to the pumps there is a duplicate intake. Should by miracle this burst, there still would remain the river intake, similarly duplicated in case of emergency. Should an explosion wreck a section of the loop or any of the cross-town mains, within three minutes any one of 200 gate valves could be shut down, cutting out the damaged section while an undiminished supply of water is ready in the hydrants of the neighboring streets.

To these precautions add that by the mere turning of a switch each station can get double the electric current needed to run the motors from no less than five independent, widely scattered sources—including two across the river in Brooklyn—and add that the fire mains are of such strong steel that nothing short of an earthquake that would level the city can snap them and you have an idea what is meant by the absolute invulnerability

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which it is possible to invest in the high pressure fire service.

Simple as is the principle of the high pressure system, as simple is the operation of this friendly monster during a fire. One of the unique features in this connection is that the electrician whose hands unleash the deluges never gets sight of the flames. Only by the amount of pressure which the fire chief in charge orders by telephone can he judge whether the blaze is a slight affair or whether it is a serious one involving the loss of lives and the stirring scenes of rescue and bravery common to big fires. Until orders are received over the telephone, the electrician's orders are never to run pressure in the mains higher than 125 pounds, for in nine cases out of ten the fire is comparatively an unimportant one where a hurricane of 300-pound-pressure streams would wreak more damage than the fire itself.

With the first stroke of the gong that taps the alarm in the pumping station a telephone operator takes his place at a telephone switchboard to await orders from whatever officer will be in command and to transmit these by means of a dial and a signal pull to the electrician, who, meanwhile, has run to the switchboard controlling the starting of the pumps. Within half or three-fourths of a minute, quicker than the firemen have been able to reach the fire, a pent-up flood at 125-pounds pressure to the square inch is ready and waiting for them.

If the fire is a small one the firemen simply couple hoses direct to the hydrants and aim their streams. Otherwise the chief in charge estimates the seriousness of the situation, hastens to the nearest telephone box which is never more than a block away and orders whatever pressure he wants, 150, 200, 300 pounds to the square inch—more than twenty tons pressure against each square foot, enough to explode an ordinary city fire hydrant like a bomb shell. What the chief really has concentrated against his fire is a water-throwing-capacity which exceeds that of all the fire engines in Manhattan and the Borough of the Bronx put together.

Should the fire be in a thirty or forty-story skyscraper where terrific pressure is required to send the water to the top floor, only a pair or three hydrants need be connected with the stand pipes in the building and clear to the top floor leaps a deluge which all the engines in Greater New York could not begin to force higher than three-fourths way up the structure. Should the fire be in an ordinary building of ten or twelve stories, streams from the hydrants could be made to leap in a solid column a hundred feet higher than the roofs of the buildings. On the other hand, should the fire be spread over a wide area of six or eight-story houses where volume of water rather than pressure is to advantage, then a great number of streams are turned on —sixty on each block, without having to use a length of fire hose longer than 500 feet.

From only eight hydrants, thirty-two lines of hose can be led into twenty-six nozzles of 1¾ or 2-inch diameter, six of the two-inch nozzles being supplied by siamesed connections from two lines of hose; from the same eight hydrants might be sent water enough to supply both the high nozzle and the deck pipe of the water tower and besides the turret nozzles of four horse wagons and ten two-inch streams supplied from twenty lines.

What a roaring, seething, stupendous thing of might the stream from the high pressure service really is must be actually seen to be appreciated. Here are a few comparative instances: To hold the nozzle of a hose connected with a fire engine forcing water at eight pounds pressure, two strong men are sufficient. If you were to crowd four Sandows around a high pressure nozzle under a full head of 300 pounds, the hose would curl upward fifty feet in air, taking the men with it and would flail and thresh in a hundred-foot arc killing, smashing and wrecking wherever it struck until the pressure were shut off. A stream under full pressure hurled against an eight-inch brick wall will bore through it, disintegrating the bricks within five minutes. A stream at full pressure striking a man at close range would break every bone in his body and hurl him a hundred feet. A stream from a bursted high pressure hose will knock a man insensible at fifty feet. So powerful is the stream that were you to hit it with an axe this would

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be tossed high in air and chances are your arms would be broken by the rebound before you could let go the handle. A single man playing one of these streams could repulse a mob of 10,000 men coming at him down a street wide as Broadway.

Just as formidable as this harnessed demon is at a fire, almost as dangerous is it for the firemen to handle. The only way in which men can at all use the streams when under high pressure is either through the turret nozzles or else by means of steel tripods sledged through asphalt and pavements that clamp nozzles as if riveted to a mountain. The heaviest ply of ordinary fire hose if

in October, a stone carelessly left inside a main during construction was shot by the flood into the nozzle of the water tower where it choked off the stream until it dislodged itself. Once, during a fire in December, a main which had been exposed during the digging of the new subway burst and caused a delay in the service which, until valves were shut off to cut out the damaged section permitted serious headway to the fire. These, however, are minor defects which are to be expected in a new contrivance and which will be eliminated as the system finds itself and the firemen get the hang of things.

As yet the high pressure fire system

HIGH PRESSURE KALEIDOSCOPE.
A partial idea of the volume of water possible to throw may be gained from this picture.

attached to a high pressure hydrant would squash open as if it were so much wet paper. The only hose to withstand the terrific strain is all rubber with walls nearly a half-inch thick.

At this writing the high pressure service in Manhattan has been in use for nearly six months. Once, during a fire

has had no test against a conflagration. Likely it never will have. For fire within districts protected by this system has met its match. During an official imaginary fire located in the street between the car tracks on West street last October, thirty-two lines of hose were led from eight hydrants into twenty-six nozzles

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STREAMS THAT OVERTOP SKY-SCRAPERS.
High pressure jets mount above the top of a fifteen-story building.

and with only 270 pounds pressure—generated by only sixty per cent of the pumps of both stations, water was thrown at the rate of 33,000,000 gallons a day. For more than the distance of a city block streams were thrown in a solid column before broadening into spray and within twenty minutes, with sewer man holes open, the street ran water from curb to curb.

One final aspect of the high pressure fire service remains. It means, of course, the saving of an inestimable number of valuable human lives. It means that hereafter Baltimore and San Francisco fires, for which even today the entire nation is paying taxes in the form of increased fire insurance rates, will be out of all question. It means that the big $300,000 or $400,000 fires which have in the past totaled an annual fire loss of hundreds of millions of dollars, will become as rare as they have been common.

Again, the high pressure service is capable of such quick installation that only seventeen months were required to build the system in Manhattan, while it is so elastic that by the mere addition of pumping units or by the erection of extra pumping stations along the line it can be increased in capacity to an almost indefinite degree.

Last but not least, the new system is so much cheaper to maintain than the fire engine system that within a few years it will more than save the cost of its own installation. The enormous appropriations which cities make annually for fire engines, horses, harnesses, fire buildings and food and repair and incidental bills will be reduced from twenty-five to forty per cent. Briefly, in the words of an expert who had much to do with the construction of Manhattan's system: "The fire engine will remain useful in sparsely settled districts and in small towns. Within five years, however, not a fire engine will be seen within the heart of any first class city in the country."

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MOVING A RIVER TO PROTECT A RAILROAD

By HARRY H. DUNN

A MOUNTAIN torrent, itself the product of two considerable streams, has been completely chained; a river has been picked up and laid down again, not where the laws of nature and of gravity bade it flow, but where civil engineers led it, as a little boy might lead a tiny stream with his finger.

Down the Meadow Valley Wash in southeastern Nevada the river ran—Meadow Valley Creek—in summer a brook three feet wide and two inches deep; in winter a roaring torrent, mile wide and twenty to fifty feet deep. Through the same canyon the San Pedro, Los Angeles and Salt Lake Railroad company had laid its tracks.

One day in March, 1907, there appeared above the Meadow Valley range of mountains a cloud, black and huge; beneath it Meadow Valley Creek babbled and purled like a child at play, singing to the overlands and limiteds that roared back at it from the pathway of steel.

Next morning there was no railroad. From Guelph to Barclay, a distance of approximately one hundred miles, the wash was a mass of boulders, uprooted trees, twisted rails and splintered ties. Sections of rail and ties, still spiked together, were standing on edge, like some Titan's picket fence; where had been bridges, hung fibrous webs of steel, skeletons of ties, supported by the rails which had not come apart when their stringers fell.

Two million dollars' worth of damage was wrought in a single night, for many cars and two or three engines went down in the flood, and next morning the Meadow Valley Creek crept softly and slowly over the wreckage, apparently satisfied with the harm it had done. From side to side the stream curved, from canyon wall to canyon wall it bent its sinuous way like a crawling snake, crossing eighteen times what had been

"THE TITAN'S PICKET FENCE."
A sample of the work done in a single night by Meadow Valley River.

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CUTTING THE END OFF A MOUNTAIN RANGE AND DIGGING A CANAL THROUGH STONE, TO CARRY THE WATERS OF THE MEADOW VALLEY RIVER BETWEEN THE ROADBED AND THE MOUNTAIN WALL.

the railroad, at places where there had once been bridges.

Today the railroad runs through the canyon, forever safe from the ravages of the storm demon; today the engines laugh in hoarse, whistling chuckles at the rage of the stream as it raves against the rip-rap buttress on which the Pullmans roll. Yet the track has not been straightened; it still winds like a snake through the canyon, one of the crookedest pieces of roadbed in the world, showing all the beauties of the rugged mountain scenery of the desert. But, every kink has been taken out of the stream; every curve where it in the least threatened the life of the railroad has been smoothed out, and the eighteen bridges have been eliminated.

Forty-five lineal miles of actual wash-out occurred in this hundred miles of track. Today such a thing is impossible;

LAYING THE HALF-TON ROCKS OF THE HEAVY BULKHEAD IN PLACE.

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today that roadbed is like a floor, a fortress of rock and earth and steel, built to last for all time and to defy not alone the annual winter rises of the Meadow Valley Creek, but to set at naught the torrents which unexpected cloudbursts send rushing down from the peaks of the surrounding ranges.

To make it so required the better part of two years, and cost $33,333.33 per mile. It is considered one of the biggest tasks ever carried through in the railroad annals of the West. Miles of new bed have been scooped and blasted out of the living rock, and the waters of Meadow Valley Creek led into it, held in bounds by man-made walls of stone, which no force, short of an earthquake, can dislodge. Three hundred yards wide in some places, a mile wide in others, at time of its greatest fury, this river has been hammered down to a uniform, tame little stream, whimpering and whining along its hundreds of miles to the Colorado. Gone is its battle cry, gone its song of triumph, for the men of the transit and the meter rod have conquered it, and this is how they did it:

Nine sections of new channel for the mad river were cut in the forty-five miles of breakage. From these nine channels 120,000 cubic yards of rock were removed, and, before the rock could be touched by the blasting gangs, 100,000 cubic yards of dirt were taken out by great steam shovels and cast along the line of the roadbed, to be used later.

Wherever the stream shows its teeth against the mountain or against a sand spit, the steam shovels and the blasting gangs have eaten away the face of the hill or cut out entirely the sandbar. Then heavy bulkheads have been thrown in, such bulkheading as guards the lowlands of the South from the rising tide of the Mississippi.

Where the roadbed crosses the stream, which it must of necessity many times because of the curves in the canyon, eight new steel bridges were put in. Six of these are of 125-foot riveted steel spans; the other two have similar spans of 110 feet. An earthquake might hurl these bridges from their place, but it could not wreck them.

THE LOST AND THE SAVED—FREIGHT CARS SMASHED TO KINDLING WOOD AND OTHERS RUN OUT OF THE WAY OF THE MAD WATERS.

In one place the entire end of a range, about a third of a good-sized mountain, was taken off by the great shovels of the engineers, solely to make a new channel for the waters. In another place hundreds of tons of sand were scooped off the bedrock, sinking the level of the stream many feet below the base of the embankment on which the roadbed rests.

Four feet under the bed of the creek, where it approaches close to the roadway,

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begins a remarkable sloping defense of rip-rap work which extends to thirty inches above highwater mark. Into this riprap went 230,000 cubic yards of selected stone, hand laid. Imagine, if you can, what it means to lay 230,000 cubic yards of stone by hand, let alone selecting each stone so that it fits in among its neighbors like the parts of some ancient mosaic, leaving a smooth, sloping front to defy the mad charge of the angry waters.

THE MORNING AFTER IN THE MEADOW VALLEY WASH.

There are sixteen lineal miles of this rip-rap, varying from seven to eight feet in width on its sloping face, carrying the tracks high above the stream. It is not a mere matter of surfacing, but extends entirely under the rails all the way through the washed out portion of the stream's bed, for the entire forty-five miles of trackage on which the water did its worst.

And some idea of the size of the wash and the destruction the flood wrought, may be gained by a glance at the map of Nevada. There it will be seen that the Meadow Valley wash drains both the Meadow Valley range and the Mormon range of mountains, on the west and east sides of the wash, respectively. From Crestline, where Clover Creek heads, a good sized stream is poured into the Meadow Valley wash, while the latter stream itself brings a large volume of water during the winter season from its heading in the Pioche country. From Caliente on down to its junction with the Muddy, the Meadow Valley River is the most dangerous of all the desert streams of the Southwest, not even excepting the Mojave at flood time.

Down the Meadow Valley wash the torrents of winter bring great boulders, up to ten and fifteen feet in diameter, rolling and bounding and pounding along in the grip of the thousands of tons of water that rush down the gorge. Hurled against bridges, thrown with terrific force into embankments, these boulders, brought from the ranges above, have been the real destructive agent of the Meadow Valley Creek. One such stone, thrown as from a catapult by the mile-wide race of waters, would take out a bridge which the water alone would require days to undermine. To such a stream, armed with such missiles of destruction, the railroad was a plaything, kindly given into its maw by the black specks which had covered the bed of the wash with their stakes the year before.

Now these boulders roll peaceably down great chutes, scooped in the bedrock, and blasted out of the mountain side, driven in an almost straight line through the gorge, and giving the creek

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a clear right of way into the Muddy and thence on down to the American Nile. Gaunt cliffs line the gorge of the Meadow Valley wash, and there are at least half a dozen more of them since the reforming of the stream than there were before. These have been made by great ugly plows and shovels, whose steel teeth have bitten off, mouthful by mouthful, whole mountain walls and set up sheer precipices where were sloping hillsides when the engineers came.

THE MAN WHO DID IT—DIVISION ENGINEER. JOHN A. SHANAHAN.

Past the faces of these cliffs, in times gone by, millions of cubic feet of water have hurled themselves with the speed of a millrace, filling the narrow places of the canyon to overflowing, burying the railroad first in water and then in sand.

Today, where the channel runs wide, the stream is led along one side of it, in a bed dug especially for it, and there it must remain, in spite of its rage, even when the flood tide comes upon it. Where the canyon narrows, this bed has been cut deeper, to accommodate the greater depth of the confined volume of water. At no time, even though the amount of water carried in the wash ex-

BITING OFF THE END OF A MOUNTAIN RANGE TO MAKE ROOM FOR TRACKS.

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ceeds that carried at any previous season in the knowledge of man, can it overflow the new banks.

Without picking up the mountain walls themselves and setting them back, lacking only the power so to do, and not the skill, the engineers of the West straightened the entire hundred miles of the creek bed, without appreciably altering the map of a canyon of equal length and from one to ten miles wide.

The flood which caused all this repair work to be performed, was remarkable for the freak things it did, as well as by being run upon a bridge, the embankment on both sides of the bridge going out, but the massive piles standing the strain which the long mound of earth could not resist. There these two cars stood until after the waters had run themselves back to the little stream which is all there is to the normal Meadow Valley River. Then the track was rebuilt and the Pullmans removed.

In the place known as "Channel Change No. 3" to the engineers, twenty-eight hundred feet of embankment went out. Three bridges were in the strip of

THE OVERLAND LIMITED GOING THROUGH THE MEADOW VALLEY WASH ON THE COMPLETED ROADBED.
When the recent flood had subsided, rails, ties and grade all had to be replaced, as there was not a vestige left.

for its size. A freight train was caught passing through the gorge just as the flood waters reached their greatest height. Part of the train went off the embankment into the mad swirl of waters, but a part of it was saved by the piling up of a bulkhead of sacks of sand along the face of the creek. Thousands of dollars' worth of freight was in those cars, and the work of one track gang alone saved all of it from destruction.

Two Pullman cars from a passenger train, also caught in the flood, were saved roadbed that was wiped off the map. All this had to be replaced, and by the cutting away of a couple of mountain spurs, the necessity for the bridges was eliminated from the new track, the stream being compelled to flow beside the track and never under or across it.

More than a thousand men fought in this battle of the engineers against the floods, and the men won. Day and night they worked, with no idea of hours or rest, until their task was accomplished, and the roadbed in such shape that the

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MILES OF RIPRAP LAID BY HAND ALL THROUGH THE MEADOW VALLEY WASH.
Probably the most carefully constructed piece of roadbed in all the West.

great Moguls pulled their laden trains through the gorge as smoothly as though they were rolling into the station at Los Angeles or in Salt Lake.

At "Channel Change No. 9," the most remarkable piece of work in the entire canyon, a point of solid stone, rising from the bedrock of the creek, and sloping backward to the mountain wall of the Meadow Valley range, was eaten away in huge mouthfuls by steam shovels and by dynamite. Boulders big as half a small house were torn from the mountain, lifted on great cranes and laid gently down in the bed of the new channel, as a base for the rip-rap which bears the ties and rails. Not even a trace of the old stream was allowed to remain; it was led into a new channel, and made to flow there, while the aeon-old pieces of stone warded it off from the railroad itself.

And when you are whirled eastward or westward, through the great Meadow Valley wash in the heart of the Nevada desert, look out of your Pullman window and think that here once a river ruled, defying man and his works, daring him to lay twin lines of steel through its bed. As you roll along next spring, beside a torrent of water which has lashed itself into foam because it cannot get at you, remember that here was fought a battle of the Titans; that here man whipped the elements, braved the thunder and the lightning and the rushing waters and conquered them all—because he was an engineer.

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THE POISON SQUAD AT WORK.

SHALL PURE FOOD BE PURE?

By RENÉ BACHE

THE pure food movement, as represented by Prof. Harvey W. Wiley, has been doubled up by a blow which — so the recipient declares, at all events — has been delivered below the belt. It is pretty nearly equivalent to a knock-out, and would have elicited painful outcries from the government bureau of chemistry; of which the eminent gentleman aforesaid is chief, but for the fact that a dignified policy of silence is considered wiser under the circumstances.

For it was Mr. Roosevelt who appointed the board of consulting experts that has had the impudence to upset Professor Wiley's decision regarding the digestibility of benzoate of soda—so what is the use in uttering any yelps? The distinguished head of the bureau of chemistry is a difficult man to hold down, and it seems not unreasonable to expect that he will be on top again before long; but meanwhile he finds himself prostrate, officially speaking, and the board of experts will doubtless hit him a few more severe knocks while the opportunity lasts.

If it were only benzoate of soda that was concerned, the case would not be so bad. But the board of experts—of which Prof. Ira Remsen, of Johns Hopkins University, is president—seems determined to reverse the Wiley policy on the subject of preservatives in general, for foods and drinks. Consequently the "adulterators"—under which head the

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chemistry bureau bunches quite a multitude of enterprising manufacturers of edible and potable products—are jumping up and down in a glee that is nothing short of ghoulish.

This state of affairs, it should be explained, takes its rise from a provision made by Congress about eight years ago, for the study of preservatives and chemical coloring matters in foods and drinks. The work was put into the hands of Professor Wiley, who, with the idea of making the investigation as practical as possible, employed the services of a number of young men, mostly government employees—volunteers who, in exchange for free board, were willing to partake of a variety of selected chemicals, such as benzoate of soda, administered with meals in gelatine capsules.

The newspapers promptly dubbed these volunteers the "Poison Squad." There were twenty-four of them, and their meals were served in the basement of the chemistry bureau—which, by the way, is a section of the Department of Agriculture. From time to time the personnel of the corps was changed, however, in order that the health of its members might not seriously suffer. They enjoyed the best of all kinds of plain food, such as the market supplied, and incidentally partook of carefully prepared doses of such familiar preservatives as saltpetre, copper sulphate, salicylic acid, formaldehyde, sulphurous acid, benzoic acid, and borax.

To make sure of the accuracy of results, this experiment was kept up for six years. Only a short time ago were the last of the volunteers discharged from duty. Some of them had been made pretty sick, but none of them died. A great many interesting facts were developed, however, in regard to the physiological effects of such preservatives, and upon these data Professor Wiley based an exhaustive report. This report condemned the use of such preservatives absolutely and unqualifiedly, and, inasmuch as Congress was disposed to back up the Wiley conclusions with appropriate legislation, there was every prospect that foods and drinks containing chemicals would be shut out of the market—when, like a bolt from a clear sky, came intervention by Mr. Roosevelt, appointing the board of experts to review Professor Wiley's decisions.

The board is composed of Prof. Ira Remsen; Prof. Russell H. Chittenden, of the Sheffield Scientific School of Yale University; John H. Long, Professor of Chemistry in the Medical School of the Northwestern University, and C. H. Herter, Professor of Physiological Chemistry, in the College of Physicians and Surgeons, New York City.

These gentlemen are all scientists of distinction. Individually, they are persons whose judgment ought to be highly respected. As a body, however, they appear to be inclined to take a few whacks, so to speak, at the government bureau of chemistry, and particularly at Professor Wiley. They are disposed to take an optimistic view of chemical adulterations of foods and drinks. Why discourage the manufacturers of such products by telling them, roughly and rudely, that they must put aside their little poisons—that these poisons are unnecessary, as well as deleterious, and that, where artificial colorings are concerned, vegetable substances, such as the natural chlorophyll of green leaves, must be utilized instead of laboratory preparations?

Perhaps these gentlemen are right. They do not assert that such poisons in indefinite quantities are harmless, but merely that the small percentages of them commonly employed are unimportant. But this is exactly where they come into collision with Professor Wiley and the bureau of chemistry. Professor Wiley is sure he knows, because he has carefully watched the effects of what might be termed ordinary commercial doses of these chemicals upon healthy young men under his daily observation. Which is correct—the bureau of chemistry, or the board of experts?

Unfortunately, from the Wiley point of view, the board of experts is the reviewing authority. Its decision governs. There is the matter of benzoate of soda for example. The board declares that, when used in ordinary commercial quantities, it is harmless. Professor Wiley asserts with emphasis that the very opposite is the truth. It did, he says, a lot of mischief to the young men to whom he administered doses of it, in

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DR. WILEY WEIGHING BREAD FOR THE POISON SQUAD.

capsules, with the meals which he furnished them.

What is benzoate of soda? The answer is that it is a mixture of benzoic acid with ordinary sal soda—carbonate of soda—in certain proportions. In this shape it is conveniently employed as a preservative in catsups, jams, marma-

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SCIENTIFIC COOKERY UNDER DR. WILEY'S DIRECTION FOR HIS CORPS OF FOOD EXPERIMENTERS.

lades, inferior wines, ciders, and especially soda syrups.

For further information on the subject the student may be referred to a textbook of chemistry by Prof. Ira Remsen, the president of the board of consulting experts aforementioned. He says that benzoic acid is commonly obtained from the urine of horses and cows. This fluid is evaporated by heat to one-half or one-third of its normal volume, and hydrochloric acid is added. On cooling, hippuric acid—the characteristic acid of the fluid in question—is deposited, and benzoic acid crystallizes out of it in the shape of lustrous needles or scales. These scales and needles are easily dissolved in hot water.

Professor Remsen says that the vapor of benzoic acid "acts on the mucous membranes of the breathing passages, causing coughing." It is, then, an irritant. But the experiments made by the bureau of chemistry, through the administration of the substance in small and repeated doses, have shown that it has a very injurious effect upon the kidneys—as evidenced, among other symptoms, by the development of hippuric acid in the human urine.

Professor Wiley contends that the use of benzoic acid, in the form of benzoate of soda or otherwise, is wholly unnecessary. It is not needed at all as a preservative. The principal reason for its employment, indeed, is to disguise inferior goods. Take such an article as tomato catsup for example. If the catsup is adequately concentrated, it will not ferment or deteriorate. But the manufacturer finds it profitable to dilute the product, and, when it is diluted, benzoate of soda is required to prevent fermentation.

One of the arguments urged in behalf of the use of such preservatives is that the employment of the latter makes it practicable to put on the market various edibles and drinkables at prices which poor folks are able to pay. It is urged by the bureau of chemistry that this claim is in effect false. For the poor man, though he may pay a few cents less per bottle for his catsup, for instance,

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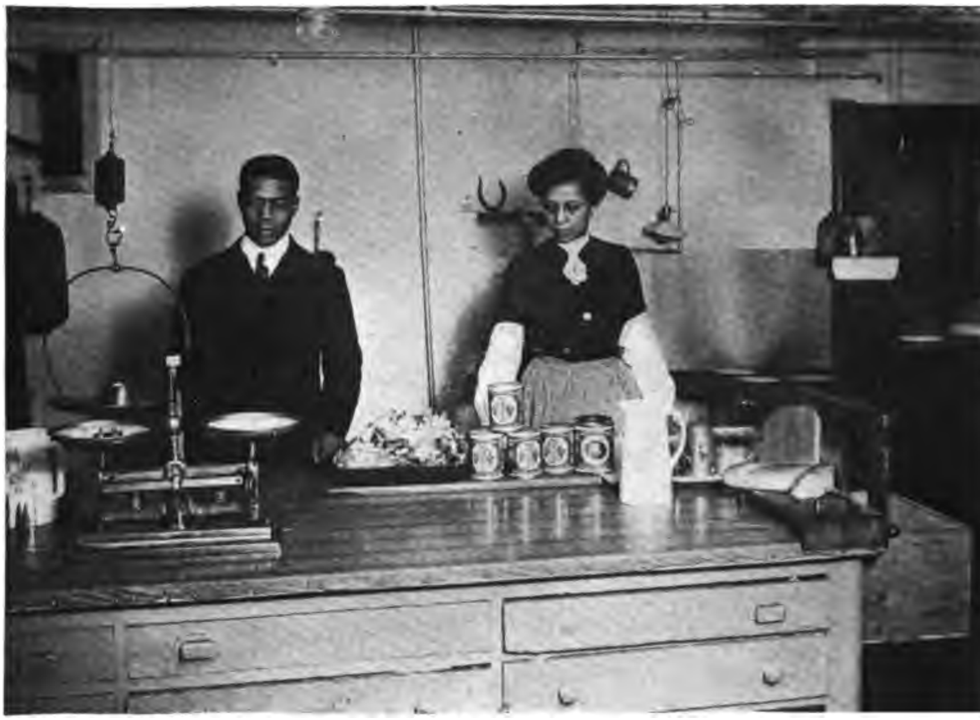
in reality gives more for the article than the rich man does, inasmuch as it is more dilute. He gets actually less catsup for his money, in point of quantity, and an inferior article at that.

One of the most common of chemical preservatives in foods is borax—frequently used in the shape of boracic acid. It is utilized in meats, in butter, in milk, and in many other things. The experiments on the "Poison Squad," with carefully graduated doses, showed that it gave rise to grave disturbances, evidenced by loss of weight, lassitude, headache, and indisposition to work.

One of the most important chemical preservatives is sulphurous acid, which is utilized by manufacturers for clarifying wines, to give keeping quality to soda-counter supplies, and for many other such purposes. It is commonly employed in the making of molasses. Observations by the bureau of chemistry indicate that it renders everything touched by it less palatable and less healthful. Doses of it were administered to the members of the "Poison Squad" sometimes in the form of sodium sulphite, and sometimes in the shape of a solution of sulphurous acid in water, drunk as a beverage. Among the results recorded were pain in the stomach, dizziness, and vomiting; also a large reduction of the number of red corpuscles in the blood. Persons affected were not able either to work or to sleep.



WEIGHING OUT PROVISIONS FOR THE POISON SQUAD.

The work of ridding the body of such poisons falls mainly upon the kidneys, which, even under ordinary circumstances, are organs greatly overworked. Saltpetre — a preservative commonly used for meats—has the additional disadvantage of irritating the intestines. Copper sulphate, as illustrated by the experience of the "Poison Squad," produces nausea and loss of appetite. Salicylic acid promotes stomach trouble and malaise, while formaldehyde exhibits its effects in a general physical depression, and sometimes in eruptions of the skin.

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A PORTION OF THE COFFERDAM, SHOWING, IN THE LEFT FORE-GROUND, THE BED OF THE DETROIT RIVER EXPOSED.

CONQUERING THE HELL-GATE OF THE LAKES

By LEN G. SHAW

FOR more than a third of a century the United States government has been striving to provide a channel in the lower Detroit River that would prove equal to the constantly increasing demands of marine interests on the Great Lakes. The conquest of the Lime Kiln Crossing, some fourteen miles below Detroit, and the most troublesome spot on the inland seas, has kept government engineers busy for years, made contractors wealthy, and annually furnished employment for hundreds of skilled drill and dredge men.

The scores of smoke begrimed, squatty looking drill boats, dredges and scows ranged all the way from above Amherstburg far down into Lake Erie have been a never ending source of interest to the hundreds of thousands of summer tourists traveling by water, and the chug-chug of the drills, the shrill tooting of whistles and the dull detonation following a blast of dynamite far below the surface have been a source of constant annoyance to residents in the vicinity. All this is as nothing, however, when compared with the anxiety and financial loss this spot has caused marine interests. Were all the collisions, groundings and other accidents that have taken place in the vicinity of the Lime Kiln crossing to be enumerated the showing would be impressive.

Now this most perplexing problem of removing this hindrance to further marine development is well along toward a solution that will, it is confidently predicted, eliminate trouble for all time.

The change is being brought about through one of the most remarkable engineering feats on record, which involves nothing less than the construction of the greatest cofferdam the world has ever known, the pumping out of an area more than a mile in length and approximately one-third of a mile in width, and cutting "in the dry" from the limestone rock forming the river bottom a course three hundred feet in width and a mile in length that will, when completed, accom-

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A CLOSER VIEW OF A SECTION OF THE COFFERDAM.

modate the largest vessels on the Great Lakes.

Singularly enough, while improvements costing millions of dollars have been made by the government in this district, the present is the first undertaking of any consequence in the lower Detroit River where American money has been spent in American waters, the course now used by vessels in passing this most treacherous spot, and where work has been in progress for thirty-four years, lying wholly within Canadian boundaries.

When in 1874 Congress made the first appropriation of $25,000 for improving the Lime Kiln crossing there was a depth of from twelve and one-half to fifteen feet of water over the rocks that formed a barrier between the lower and upper lakes. Then "windjammers," the great white-winged sailing vessels whose usefulness has long since been outlived, were in evidence, and the three-hundred foot boat was looked upon as a marine marvel. Now the six hundred foot mark has been passed in marine architecture; the depth of water at the Lime Kiln crossing has been increased to twenty-one feet and is still inadequate; the oldtime sailing vessels have given way to steam propelled craft and rest in the boneyard, and the tonnage passing up and down the Detroit River during the season of navigation is greater than at any other point in the world. The massive freighter having 10,000 tons of iron ore aboard no longer attracts attention, and the record for a wheat cargo is already well over the 420,000 bushel mark for a single trip. Day and night during the months when the lakes and rivers are not ice locked there is a never ending procession of these monster boats, racing from one end of the lakes to the other and back again, discharging cargoes in record time, a ceaseless rush after dividends providing a marine pageant whose equal

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ANOTHER PART OF THE WORKS, SHOWING PIPING THROUGH WHICH A CONSIDERABLE AREA WAS PUMPED DRY.

can be found nowhere else, and whose limitations have by no means been reached.

With this rush of ore and grain from Lake Superior ports and a like transfer of coal and package freight from the Lower Lakes to the Northwest conditions rapidly reached a point where they were at times intolerable, and the need of further improvements became imperative.

It was slow work drilling and blasting and dredging at the Lime Kiln crossing in such a manner that commerce would not be interfered with. The winter months, when work could have been pushed without interruption by vessels, brought enforced idleness because of ice and the fact that dynamite can not be used effectively in water of such low temperature as prevails at this time.

THROUGH THIS AIR LIFT 2,000,000 GALLONS OF WATER PASSED EVERY HOUR.

Inch by inch the battle against the rocky barriers was waged, and as fast as the waters at the Lime Kiln crossing were deepened vessel builders increased the draught of the new boats accordingly. It was a race between the dredgemen on the one hand and vessel interests on the other, in which the latter were often placed at a serious disadvantage by adverse winds that lowered the level at the crossing to a point where the big freighters could not slip across the barrier of rocks until the gale had subsided, thus entailing delays that proved costly.

Threading the narrow and tortuous course required a high degree of seamanship at best, and the rapid increase in the number of vessels resulted in congestion at this point leading to frequent mishaps.

Then the government decided to end the trouble and provide a new channel to

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the west of the present one which would be sufficient for all time, giving a course for downbound boats and permitting upbound craft to use the present one.

Using Stony Island, a marshy tract some few acres in extent, as a starting point, the contractors began construction of the largest cofferdam ever undertaken. Dredges were used in casting up the walls of rock and clay, taken from the river bed at various points in the new channel where excavation in the old way was comparatively easy. An area 2,800 feet in length and with an average width of 1,600 feet was enclosed by a wall some forty feet through at the base, reaching ten feet above the surface of the river, and at the top being wide enough to permit the laying of a narrow gauge railroad track if desired.

It was no easy task constructing this dam. The current at this point is very swift, and powerful eddies were formed by an abandoned railroad pier at the upper end of the dam. To add to the troubles of the contractors there was the constant wash from passing vessels, these factors not only having to be reckoned with at the time but the possibility of trouble from this source in future guarded against. Several months were required to complete this wall, capable of withstanding the terrific strain to which it was destined to be subjected. Once it was finished, the real danger confronted the contractors, the success or failure of the undertaking depending entirely on developments at this stage.

End of Air Lift Flume, Through Which 50,000,000 Gallons of Water Passed Every Twenty-Four Hours.

Two twelve-inch centrifugal pumps, each with a capacity of 6,000,000 gallons of water every twenty-four hours, and a battery of fifty air lifts, with a combined capacity of 50,000,000 gallons daily, were started, and the flood inside the cofferdam began to recede. In spite of the magnitude of the job, so thorough had been the work of building the dam that no leaks of consequence developed, and within ten days after the first water found its way through the pumps one hundred and thirty acres of the river bed was exposed so completely that it was possible to walk dryshod over the entire area.

Marine men who watched the progress from the outset, and who had scoffed at the possibility of success, stood aghast when from the deck of their own vessel passing within a few hundred feet of it they beheld the great gash in the river. Veteran contractors who scouted the idea of working in this manner were compelled to admit that they were wrong.

With the water out of the cofferdam, excavating was undertaken. Great towers, more than one hundred feet in height, and mounted on tracks permitting their being moved wherever desired, were erected 720 feet apart, being connected by cableways capable of sustaining a weight of ten tons, and on which ran ten-ton "skips" or trays, operated by compressed air and manipulated so that they could be dumped in midair without the slightest delay.

Channelers were put at work, these knife-like devices cutting courses through the rock lengthwise of the channel and some six feet apart. At regular distances across the proposed channel holes were drilled at angles, filled with dynamite, and the charge exploded. Then the sixty-five ton steam shovels were put in operation loading the skips,

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and the task of gouging out a channel through the solid Niagara limestone was well under way.

It all seems simple enough on paper, but it involves one of the greatest engineering feats of modern times. For a distance of approximately one mile it will be necessary to hew a course 300 feet wide and with an average depth through the solid rock of nineteen feet. In round numbers 1,500,000 cubic yards of rock will have to be removed, at a cost of $1,000,000.

Before the first cofferdam had been completed, dredges were at work on two others which will join it, both being the same width, one having a length of 1,500 feet and the other 1,200. When these are completed and pumped out the center walls will be removed, giving a clear stretch for the channelers and .shovel men, of 5,500 feet, or considerably more than a mile. When the last of the rock has been removed, a task that will require two years of working day, and night, the end walls will be cut away and the water let into the channel, the side walls of the cofferdam being left intact as a guide for vesselmen and for use should it ever be deemed advisable to widen the channel in the same manner.

The new channel, named after William Livingstone, president of the Lake Carriers' Association, will be some fourteen miles in length, including the mile that will be done in the dry, and will cost, when completed, $2,000,000. It will give a course with an average depth of twenty-two feet from mean level.

Working in the dry involves a deal of detail and preparation unknown in the old subaqueous plan, although far more expeditious and consequently cheaper. Every bit of machinery at Stony Island is operated by compressed air, two compressors with a combined capacity of 1,000 horsepower being employed. These take 5,300 feet of fresh air every minute, compress it to a pressure of 100 pounds per square inch, and transmit it to various points, in some instances the air being reheated before being used, thus greatly increasing the efficiency. In addition to the compressor plant and boiler rooms, there are the great towers running on tracks, with their ten-ton cableways, the pumps, the steam shovels, the channelers, a complete railroad system with locomotive, and numerous other mechanical appliances.

SECTION OF COFFERDAM BEFORE IT WAS TIMBERED OUT.

A village complete in every detail has been established at Stony Island and populated by the hundreds of men employed on the work and their families. There are pretentious dwellings, a general store, a public school with a teacher hired by the company, a church, dance hall, everything, in fact, but a saloon and a jail. It is a rule of the contractors not to permit a drop of liquor on the island, which they rule absolutely, and in spite of a considerable foreign population it is doubtful if a more orderly community could be found in the world.

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MOTOR-BOATING FOR PLEASURE

By DARWIN S. HATCH

WE have become accustomed to thinking of motor-boating as one of the sports of the rich. But when we learn that full sized motor-boats can be bought for less than a hundred dollars we begin to realize how mechanical development has enabled the man of small means to enjoy the recreations of his wealthy neighbor.

The uncertainty of sails and the skill required in handling them make their use rather limited. The expense and weight involved have a like effect on steam propulsion. The motor-boat has none of these drawbacks, and its ease of operation and wide adaptability have given it the popularity it deserves. Little more than a decade has passed since the first motor-boats began to develop from the so-called "naphtha launches." Now every harbor and nearly every inland waterway is dotted with these swift little craft.

Motor-boats mean only the racing type to most people, but it is in the more comfortable and safe moderate speed boats that the most pleasure is found. There are as many different types of motor-boats as there are of automobiles. The cruising type, built for moderate speed, safety, reliability, and fuel economy has the widest use. They can go where the pleasure steamer cannot; can keep pace with the fastest yacht, and can be handled in hundred of situations where the steam yacht would be helpless. A boat of this type has made the trip from New York to New Orleans through the inland waterways, and all on her own bottom. The route lay through the Hudson, Erie Canal, Great Lakes, Illinois and Michigan Canal, and the Mississippi.

A SPEEDY CRAFT SUCH AS THIS OFFERS AN EXHILARATION UNKNOWN IN ANY OTHER SORT OF BOAT.

A sixteen foot motor-boat fitted with a two horse-power engine and capable of a speed of five miles an hour can be

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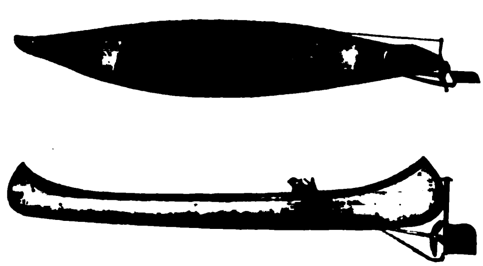
obtained for as low as $200. The cost of running is very low, as the ordinary two horse-power engine of the two-cycle type will require about five cents per hour for gasoline. The first cost and expense of operation, of course, increase rapidly with larger boats, higher speeds and more elegant furnishings.

A TYPE OF BOAT THAT SERVES WELL AS A PLEASURE CRAFT FOR FAMILY AND FRIENDS.

A boat, to give satisfactory service, must be properly designed. With the exception of the ports along the Atlantic Coast and in the Great Lakes, there are few boat builders who have any conception of the modern boat and who could, by any possibility, design a model that would be up-to-date, or who have the facilities to build the frames properly after it has been designed. The transportation charges on completed boats are very high, unless the purchaser lives on a water route where the boat can be delivered under its own power. The freight often costs as much as the boat does if it goes to any distant point.

Several manufacturers of motor boats make a specialty of selling the frames of the boats and shipping them in a "knocked-down" or unassembled condition. The purchaser reassembles the frames and completes the boat, according to the manufacturers' directions. The first cost and the freight on crated boat material is only a small fraction of that for the completed boat. If the purchaser of properly constructed frames happens to live where he can buy the other lumber necessary for the completion of his boat at home, he also saves the freight on this material.

"What! I build a boat!" you say. "I would very much enjoy running a boat built by myself, but I don't know a keel from a rudder." If these frames are furnished by a reputable company, there is always furnished with them full-sized, exact paper patterns from which to cut the planking, and complete detailed illustrated working instructions for completing the boat ready for the water. Where these frames are properly made in a boat-building factory; where they have been fitted and finished to the minutest detail; where every rib has been bent to its exact shape, stayed and beveled for the planking; where all the parts which, through any error on the part of the purchaser, might be reassembled incorrectly, have been finished permanently, ready for the water, and where these frames have been



CANOE PROPELLED BY ELECTRIC POWER.
Note the small space occupied by the motor.

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A RACING CRAFT THE JOY OF SUMMER HOLIDAYS.

set up by expert boat builders, trued and tested, ready for the planking before taking apart for crating and shipment, the technical part is done, and any purchaser of ordinary intelligence can finish the boat and make as good a job of it as could the best boat builder. The balance of the work after the frames are ready is a simple carpenter's proposition, and requires no extraordinary skill and no particular mechanical ability. Beside this, if the purchaser does not wish to go to the trouble of completing the boat himself, he can hire any ordinary house carpenter at far less than boat-builders' wages to complete the boat for him. From frames of the kind mentioned, especially if they are sent to any point where there is a high freight rate, the boat can be put in the water, ready to run, for one-third to one-half the cost of an equally good completed boat purchased from a reputable boat builder.

The size of motor to be used in the boat will depend upon the type and size of the boat and the speed desired. Boat-makers will recommend the best size of motor to use under the given conditions. Motors are built of two distinct types, the two-cycle motor and the four-cycle motor. This depends upon the number of active impulses for each stroke of the piston. There is little choice usually between the two types. The two-cycle motor is lighter and simpler while using a little more fuel per horse-power than the four-cycle motor. The former is used the more widely for marine purposes, while the latter has monopolized the stationary field and is being adopted to some extent for the larger boats.

If the piston rings are accurately fitted, a multiple cylinder engine may be "started on the spark," that is, without cranking. One manufacturer makes three-port, two-cycle engines arranged to start by pushing a button, an operation as simple as turning on an electric light. The theory is that when an engine is stopped, an unexploded charge remains in the cylinder, and when a spark is brought in contact with this charge, it explodes it and drives the piston down. An explosion is made automatically in another cylinder and the engine continues to run. To start an engine with a push button it is necessary that the piston be on the downward stroke. If it is on the upward stroke, the engine will start in the wrong direction. A push-button switch having a button for each cylinder is furnished and the fly-wheel is provided with a mark showing in which cylinder to make the spark.

AN ORDINARY ROW-BOAT EQUIPPED WITH A DETACHABLE MOTOR.

Another company advertises an engine which it is so confident will always start without cranking that it never furnishes

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a crank. This engine is also reversible and requires neither a reversing clutch nor a reversible propeller. In nearly all cases, a reversing mechanism is necessary to change the direction of motion of the boat. This is often accomplished in the smaller boats by means of a reversible propeller. In the larger sizes, a reversing gear is used to make the propeller turn in the opposite direction to the engine crank shaft, and thus make the boat "go astern."

THE *ROBERTA*. A CURIOUS BUT COMFORTABLE LOOKING CRAFT.

No discussion of this subject would be complete without mentioning the so-called "out-board outfit." This is a combination of motor, tiller, and propeller that can be attached to the stern-post of any small boat. Tightening with a wrench three bolts in two clamps that grip the upper and lower ends of the post is all that is required. No alteration in the boat is necessary, and no tool other than a wrench is required. Not only can it be quickly attached to any boat, but it can be as quickly detached, and packed away in a box in which it is carried. It takes from two to five minutes to fit up any boat ready to run with this outfit. It gives a good rate of speed, too, for it will drive a twelve foot dingey at the rate of six miles per hour.

While most of us prefer to be comfortable and safe rather than speedy, to many the delights of high speed and the excitement of racing strongly appeal. Motor-boat racing offers all the excitement of automobile racing with few of its dangers. There are many speed-launches and racers on the market, although comfort and seating capacity have been made secondary to speed. A forty-foot racer with a fifty horse-power engine will, if properly designed, maintain a speed of from twenty to thirty miles an hour. The engine for the purpose must be very carefully selected in regard to lightness and reliability.

A motor boat, the *Roberta,* of a new type has recently been put in service in Pittsburgh waters by its inventor, Fred J. Heavens, an electrical engineer of that city, member of the American Institute of Electrical Engineers.

His most radical departures from the conventional forms of boat construction are the placing of the propeller under the middle of the hull, and the absence of a keel, the skag taking the place of the latter. This skag is one-quarter inch by

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one and one-half inch flat iron on edge and gives sufficient steering way for all purposes. The inventor claims that increased speed is obtained by placing the

THE BROAD, STAUNCH-BUILT KIND THAT ASSURES SAFETY TO THE PLEASURE SEEKER.

propeller under the middle of the boat, as the power is thus applied more advantageously, through the fact that the purchase of the flukes against the water is constant at all points on the circle described by the revolving propeller. This is due, first to the fact of the bottom of the boat being perfectly flat, and, consequently, not disturbing the water to so great an extent as would a round hull, and, second, to the weight of the boat on the water being directly above the propeller, thus giving the latter a solid body of water in which to work.

Another unusual feature of this boat is in the placing of the engine, which is set only four feet from the front, whereas the ordinary plan is to have it in the rear, or at the most, not more than one-third the distance from the stern. As the engine of the *Roberta* weighs only thirty-five pounds it was feasible to put it in front. Small as it is and with only one and one-half horse-power it drives the natty little boat through still water at the rate of six miles an hour. The craft's towing power is extraordinary, as was well shown on one occasion when it towed a flat boat ten by twenty-five feet, loaded ten feet high with camp equipment and containing three passengers, besides three other persons in the boat itself—all this against a stiff current in the Allegheny River, a feat its inventor is doubtless proud of.

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THE NEW SCHNEIDER AEROPLANE.
Side view of machine for which great things are prophesied.

THE LATEST IN FLYING MACHINES

An Aeroplane that Must Fly

By C. F. CARTER

IN a disreputable looking shed at Morris Park Race Track, New York, is housed the latest development in aeroplanes. It embodies, and improves upon, all the good points in the Wright and Farman machines, the most successful of its predecessors, and has, besides, many important innovations introduced by the inventor, Frederick Ernst Schneider of Brooklyn.

As Schneider's machine has never yet left the ground all these positive assertions and much more to the same purpose are based solely on what everybody says, the term "everybody" being limited in this connection to everybody at Morris Park. The famous old race track having outlived its usefulness as a betting ring, at least while Governor Hughes occupies the executive office at Albany, it has been leased to the Aeronautic Society, a corporation composed of enthusiasts on the subject of mechanical flight. The long rows of stables, that once sheltered pampered horses which gave frequent demonstrations of their inability to run as fast as some other horse, are now filled with industrious inventors toiling behind locked and guarded doors upon

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Frederick Ernst Schneider, Whose Aeroplane is Said to Mark a Forward Step in Aeronautics.

weird looking contrivances with which they hope to prove their power to outspeed any horse without the trouble of running at all. The biggest shed is devoted to an aeronautic academy where, on Saturdays and Sundays, a large class gathers for instruction in the science of aerial navigation.

The Schneider aeroplane, being at present less notable for what it has done than for what it is going to do, is obliged temporarily to divide public interest with the impressive fact to which it has called attention: that knowledge of aerial navigation has now progressed so far that men versed therein can predict in advance of its trial trip what a flying machine will, or will not, do with all the assurance with which the performance of an automobile can be foretold.

Speaking of automobiles, the scenes at Morris Park afford a striking parallel to an event at the dawn of the automobile era. Fourteen years ago the first automobile "race" ever attempted in America was held at Washington Park Race Track in Chicago. As photographer for the *Record-Herald,* under the auspices of which the meeting was organized, it was my privilege to witness those first feeble attempts at motoring. As none of the few uncouth machines entered could stagger around the smooth track without frequent stops for adjustment, repairs or rebuilding, I had no difficulty whatever in getting all the photographs required.

Just as there are today multitudes who simply know that flying machines can never fly, so fourteen years ago there were quite as many who could prove that automobiles never could get over the ground. One Chicago newspaper in particular derived several columns of amusement from the absurdity of the attempted race. To go a little further back, an officer of the Erie Railroad in 1837 demonstrated conclusively by an algebraic formula that a locomotive could not move up an ascending grade by its own power; yet at that time a locomotive built by William Norris had been running up a grade of 367 feet to the mile at Philadelphia daily for eight months.

The flying machines at Morris Park seem no more fantastic than the automobiles at Washington Park appeared fourteen years ago. Probably they resemble the efficient flying machine as it will be developed in the future about as much as the extraordinary contrivances then exhibited at Chicago looked like a 1909 model touring car. If the flying machine fourteen years hence has more broken necks to its credit than the automobile has scored in its time it will have done wonders.

A Front View of the Schneider Aeroplane.

One very great advantage which the devotees of aerial navigation have over the pioneers who developed the automobile is that they will not have to devise and perfect a motor before they can make any progress. In response to the require-

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THE *SILVER DART.*
One of the aeroplanes which has made recent successful flights.

ments of the automobile and the motor boat the gasoline engine has been developed to a wonderful degree of efficiency. All the aviator has to do is to find out exactly what he requires and then adapt the already perfected motor to his needs.

This brings up the reason why the Schneider aeroplane has not yet flown. It's all in the motor. The engine adopted had behaved itself irreproachably on automobiles and motor boats and under sundry other trying conditions; but the instant it was called upon to propel a flying machine it balked and bucked and sulked and did everything a depraved motor possibly could do but run decently. But the German inventor, with the imperturbable equanimity of his race chastened by three years' service in the navy of the Fatherland, tinkers on unruffled. By and by he will conquer that motor and then ——

Well, everybody says he simply *must* fly because his machine is so correct in design that it cannot do anything else. If everybody is right in this prognosis it becomes of interest to learn how a machine can be so built as to make flight certain.

To begin with, the Schneider aeroplane is much like that of the Wright Brothers in general appearance. That is to say, the most conspicuous feature is the double planes, frames thirty feet wide by six feet long, as compared with forty feet by six and a half feet, the dimensions of the Wright planes,

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A Test of the United States Army Dirigible, the *Baldwin*.

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THE *SILVER DART* IN PREPARATION FOR FLIGHT.

over which is tightly stretched muslin treated by a secret process to make it water and air tight. The planes, which are spaced five feet apart, are curved downward at the rear. The total length of the machine from the tip of the snout to the tip of the rudder is twenty-eight feet. The frame work is of ash, braced with piano wire and so strongly constructed that it withstood unharmed a test in which two men weighing two hundred pounds each swung themselves from opposite ends. The total weight of the machine is four hundred and fifty pounds, as compared with nine hundred pounds, the weight of the Wright machine, and eleven hundred pounds, the weight of the Farman aeroplane.

THE *LOON* IN ONE OF HER EXPERIMENTAL STARTS FROM THE SURFACE OF A LAKE.

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The front rudder, which is used for ascending and descending, is twelve feet wide by three and a half feet deep. It is supported horizontally on a snout extending eight feet in front of the planes. The snout is a framework of ash over which muslin is stretched about three feet in diameter at the base where the pilot sits and tapering to a wedge-like tip at the front.

In addition to this front rudder there is a plane four by eight feet over the rear rudder, the principal use of which is to balance the machine but which will also help in ascending and descending.

Most important of the innovations introduced are the means provided for maintaining equilibrium. One of these means is the motor itself. The motor differs from others in having a fixed crank shaft around which the five cylinders revolve. The inventor of this motor intended among other things that the revolving cylinders should cool themselves by their rapid motion through the air. Also the flying mass of metal makes an excellent substitute for a flywheel without any addition to the weight.

As adapted to the Schneider aeroplane the crank shaft is mounted vertically so that the cylinders revolve around it in a horizontal plane. As the motor is geared to twelve hundred revolutions per minute it is expected to answer the purpose of a gyroscope in keeping the airship on an even keel. The motor is exceptionally light and powerful, being rated at thirty-six horse-power, as compared with twenty-five horse-power of the Wright Brothers aeroplane, and weighing but ninety-seven pounds.

To help out the gyroscopic motor in preventing awkward spills, there is another notable new feature in the form of equilibrium planes, six feet by three and a half feet, hinged at their centers at either end of the main frame between the principal planes. These equilibrium planes, which can be moved up or down at the will of the pilot, are so arranged that when one tilts down the other tilts up, and *vice versa.*

Still another feature which is expected to contribute to steadiness of motion is the triple screws. These have two blades each and are six feet in diameter. One screw immediately back of the motor is run by a very short counter shaft. The other two, one on either side of the center screw and a little above it, are run by chain gear. The chains run through tubes and the sprocket wheels are cov-

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THE *JUNE BUG* IN A SUCCESSFUL CROSS COUNTRY SAIL.

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ered over, so as to prevent the possibility of fouling. If one screw breaks down the machine can be navigated by the other two, or even by one.

The machine is steered laterally by means of three rudders. The principal one is ten feet back of the main planes and is mounted on the same shaft as the rear supporting wheel, which is covered with muslin, making the total surface of the rudder ten square feet. At each lower front corner of the main planes is an auxiliary rudder[1] with an area of five square feet. These work with the main rudder. The auxiliary rudders also serve the purpose of supports in alighting, so that there is little danger of the corners of the planes breaking by running into the ground. The machine when at rest is supported on three wheels with pneumatic tires and with springs to ease the shock of alighting. The perverse motor worked long enough to show that the triple screws will drive the machine along the ground at good speed and that it can be steered by means of the rear wheel on the rudder post. Hence the inventor expects to be able to start anywhere without assistance and to alight with equal facility.

THE GIRARD AIRSHIP.
A novel creation designed by a Kansan.

The operator, who sits between the two main planes at the level of the lower one and at its front edge with his legs protected from the wind by the base of the snout, has four steering wheels to man-

THE FRENCH FLYER *DELAGRANGE.*

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age. Three of these mounted on the same shaft directly in front of him are worked by the hands, while the fourth which controls the back plane, is operated by his feet.

The inventor is an expert machinist who learned his trade with German thoroughness in the "old country." He came to America five years ago and has since been employed as an erecting engineer. He has constructed a number of dairy plants for Nathan Straus, the philanthropist, in the United States, and half a dozen more in England and Germany.

When he decided to build an aeroplane he shut himself up in a shop in Brooklyn and in three months the thing was done. He had no assistance and no one knew what he was doing until he drove up to the headquarters of the Aeronautic Society at Morris Park with his machine on a truck and asked permission to use the grounds to try it out. The necessary formalities being arranged, the machine was set up in its shed, where it created something of a sensation among the aeronautic enthusiasts.

When everything was ready it was trundled out on to the track, the pilot took his seat and opened the throttle. Nothing happened, nor has anything happened yet, for the motor simply refuses to work when by so doing it can be of any use. Under the shed where it can not possibly do any good it spins like a top so long as it is fed gasoline.

But once Schneider convinces that motor that he is Boss he simply ***must*** fly.

Of course he must.

Everybody says so.

THE UNITED STATES DIRIGIBLE BALLOON, *BALDWIN.*

New Aeroplanes and War Balloons

By WILLIAM WALSH

But if Schneider's machine has as yet refused to work, there are other new aeroplanes that have made successful flights. The *June Bug,* designed by the Aerial Experiment Association of Hammondsport, New York, is one of these, though it has since been superseded by the *Silver Dart,* which will presently be described

In its construction, the *June Bug* has two main superposed aero surfaces, with a spread of forty-two feet six inches, including wing tips, with a total supporting surface of 370 square feet.

The motor is of twenty-five horsepower, eight cylinder. It runs at 1,200 revolutions per minute. The total weight of the machine with motor is 650 pounds.

The *Silver Dart,* just mentioned, was built under the direction of J. A. D. McCurdy of the Aerial Experiment Association. It made its first successful flight at the grounds of the Association at Stony Brook farm on December 15 last. There were three separate trials, each of which proved satisfactory.

In the *Silver Dart,* the propeller is placed differently than in the *June Bug.* Not only is a forward motion for the

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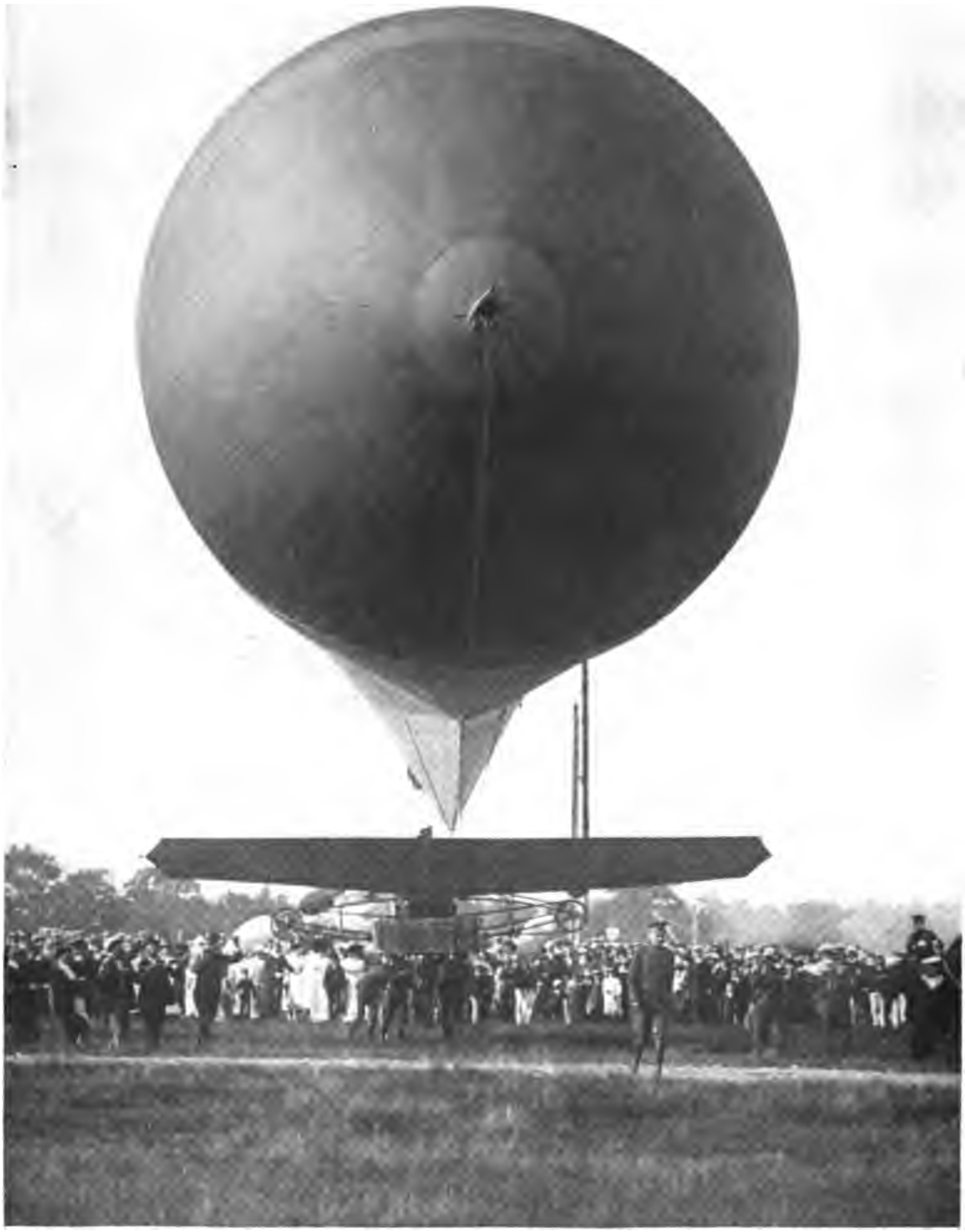

REAR VIEW OF THE NEW BRITISH WAR BALLOON, *NULLI SECUNDUS*.

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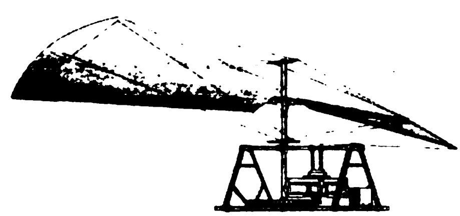
H. FARMAN ABOUT TO START IN HIS SUCCESSFUL AEROPLANE.

whole machine obtained by the new arrangement, but a buoyant or lifting effect is also produced. The engine is of similar design to the *June Bug,* but is of twice the horse-power.

The total weight of the *Silver Dart,* including its burden, a man weighing, say, 150 pounds, is 860 pounds.

Emile Berliner, a native-born German, now a resident in the United States, has turned out a new type of motor-driven aeroplane which he believes will give new impetus to aerial flight. Mr. Berliner calls his invention an "aeromobile," and the tests that he has made convince him that an airship driven by his device will travel one hundred and fifty miles an hour. His aeromobile consists of a frame carrying



EXPERIMENTAL APPARATUS OF THE BERLINER FLYING MACHINE.
Lifting power in fixed position is 360 pounds.

an extra light gasoline motor geared to a shaft, upon the upper end of which is a two-blade propeller. The superficial area of the blades is thirty-six square feet, with a length over all of seventeen feet. The blades have the appearance of the revolving fan that is frequently seen suspended from the ceiling in restaurants in the summer time. Placed horizontally, Mr. Berliner's propeller is capable of lifting three hundred and sixty pounds in calm air, straight upwards.

"There is no gas bag and no aeroplane," says Mr. Berliner, "simply a motor weighing one hundred pounds,

FLIGHT OF THE FARMAN MACHINE.

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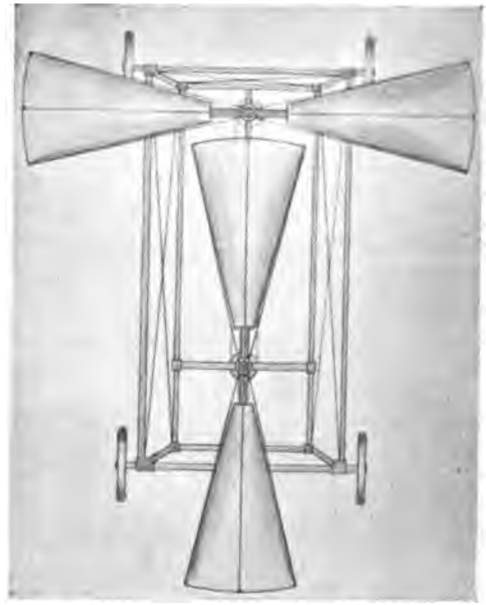
some framework, gearing and a two-bladed fan. Moreover, the whole apparatus, outside of the seat of the operator, is entirely of steel and aluminum, and is built substantially and for practical use. In order to propel the aeromobile horizontally the propeller will have to be tilted forward, and I have calculated that, while this would reduce the lifting power less than three per cent, the resulting forward thrust would be one-quarter of the lifting pressure.

"It is an accepted theory, which has been proved by practical tests, that a propeller moving forward is more efficient than when moored fast in one position. Hence, the lifting power of an aeromobile would increase in free flight.

"A peculiar importance of these experiments," says Mr. Berliner, "lies in the fact that a power propeller capable of flying straight upward with an operator would, when attached vertically to a modern aeroplane, force the latter through the air at a very high speed, probably from seventy-five to one hundred and fifty miles an hour, and would

EMILE BERLINER. WHO EXPECTS HIS "AEROMOBILE" WILL TRAVEL ONE HUNDRED FIFTY MILES AN HOUR.



SCHEME OF INTERLOCKING TWIN PROPELLER OF AEROMOBILE. UNDER CONSTRUCTION.
Lifting power in fixed position 720 pounds.

double the present speed of dirigible balloons.

"I am planning also to apply small aeroplanes to this apparatus of just enough surface to help in lifting and in landing. There will be the usual rudders, such as are used on dirigibles and aeroplanes.

"Aeromobiles would be model apparatus to have on board of war vessels to be sent up at a moment's notice for scanning the area beyond the ship's horizon for the vessels of the enemy," continues the inventor. "They would be hard to hit by shot and shell, and the propeller could have steel spurs, which would rip the enemy's balloons by merely touching them."

A curious machine also of the aeroplane type is that invented by Henry Laurens Call of Girard, Kansas. It is designed for navigation in the air, on the water, and as an automobile runabout. It has had but one test, and unfortunately a recent storm blew down the flimsy pavilion in which it was housed, and smashed it hopelessly. Arrangements, however, have been made for the construction of another machine.

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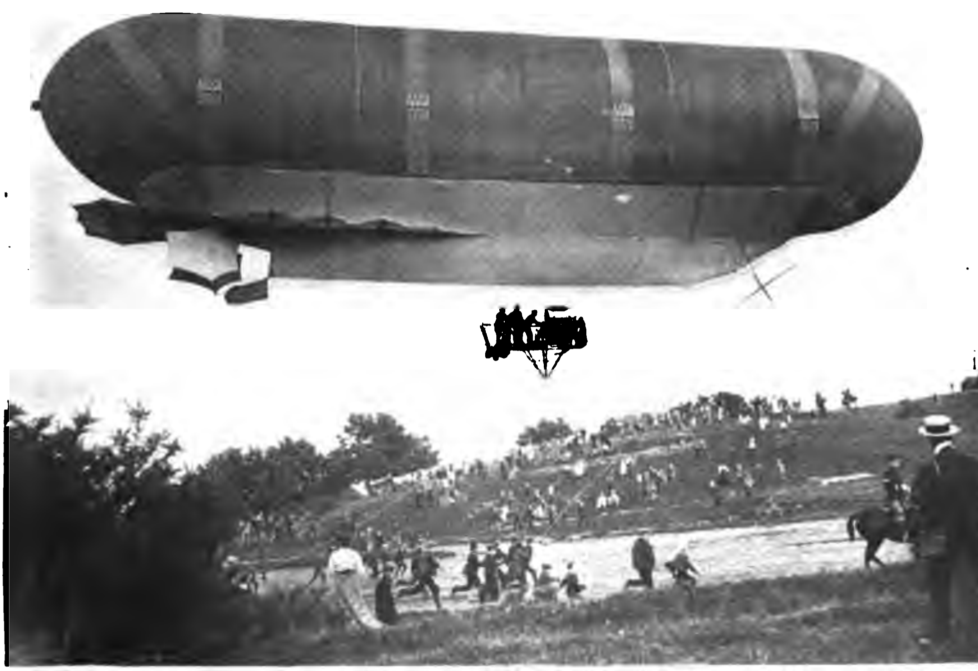
FULL VIEW OF THE NEW FRENCH AIR-SHIP, *REPUBLIQUE*.



FULL VIEW OF BRITAIN'S NEW *NULLI SECUNDUS*.

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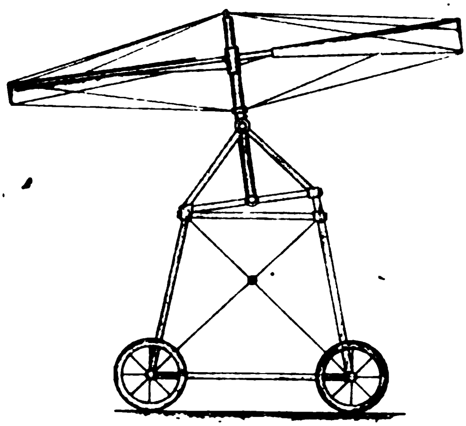
At the present time the various governments are encouraging aerial inventors, chiefly with the idea in view of putting their devices to military use. Small fleets of them already are being assembled.

Thus, France has four large dirigible balloons. One of these is the *Republique*. It is the intention to build twenty-eight ships of the *Republique* type—these to be distributed at Paris and at various forts throughout the country. In their purchase of the Wright Brothers flyer the French have secured a most important acquisition. The balloon type just now in favor in England is the *Nulli Secundus II.*



BERLINER'S SCHEME OF PROPELLING FORWARD BY TILTING PROPELLER—INCLINATION 158.
The horizontal push is 25 per cent of lifting power.

The photographs of this new dirigible balloon, with which the officers of the British army are experimenting, show just what this aerial engine of warfare is like when viewed closely. She is towed out of her shed, stern foremost, already fully inflated, and straining at the ropes which hold her down. The fins and

GONDOLA OF THE NEW BRITISH WAR BALLOON, *NULLI SECUNDUS.*

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planes and rudders by means of which she is steered, are plainly visible, and it will be noticed that the rudders which deflect her course to the right or to the left are in front instead of at the rear. The end view looking at her stern, shows how the sausage-shaped cylinder of gas rests upon a sort of hull with a keel, in form similar to that of a ship, and from this is suspended the car. At the forward end of this hull, on either side, is a series of five horizontal projecting fins, by means of which the airship's course can be deflected upward or downward, as desired. On a level with the bottom of the keel, but at the stern, is a transverse horizontal aeroplane; this is an additional rudder .for use in rising or descending.

The forward half of the car, which is made of hollow steel, is devoted to a gasoline motor, which operates a pair of propellers, one on each side. These propellers are for use in driving the balloon against the wind. All the mechanism is in this car and behind it there is a platform large enough for two or three men. This is surrounded by rope netting and along the railings are the attachments to which are fastened the ropes by which the rudders and fins are operated.

CAR OF THE FRENCH BALLOON. *Republique.*

The United States in its purchase of the Baldwin airship committed itself to a policy of maintaining airships as a part of military equipment. This is the only one of the three aerial craft that fulfilled government requirements during the trials made last summer at Fort Meyer, Virginia, the accident to the Wright Brothers' aeroplane preventing that machine from completing the tests that were required.

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BOTH THESE SAMPLES OF WHEAT WERE GROWN IN THE FIELDS.
The effect of electric treatment is shown in those nearest the center in each comparison.

ELECTRICITY STIMULATES PLANT GROWTH

By DR. ALFRED GRADENWITZ

BERLIN CORRESPONDENT TECHNICAL WORLD MAGAZINE.

THE first attempts to use electricity as a means of stimulating the growth of plants were made by the Abbé Berthelon as far back as 1783, when the knowledge of electrical phenomena was still in its very infancy. This experimenter installed some kind of lightning conductor terminating in a series of discharge points just over the plants to be acted upon, and according to his report, an improvement in the appearance of vegetation and an increase in the fertility of the plants were noted. How important a factor electricity is in connection with plant growth was then demonstrated in 1879 by Grandeau, who found the development of a plant to be greatly retarded by a wire cage protecting it against atmospheric electricity.

While many other experimenters observed similar phenomena, the subject was first treated in a systematic manner by Professor Lemström of the University of Helsingfors, who, about thirty years ago, was engaged in elucidating the mechanism of the Aurora Borealis by imitating artificially its appearance. High tension electrical discharges of various kinds were to this effect sent through vacuum tubes until a phenomenon, very much like the Northern Lights, was obtained.

Now, it so happened that some of these experiments being performed in the Professor's greenhouse, he noticed incidentally that the plants in the latter seemed to thrive under the treatment,

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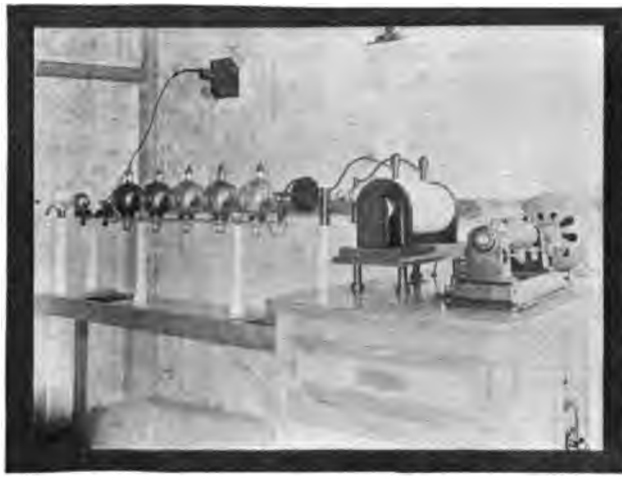

Apparatus Employed to Carry on the Work of Hastening the Growth of Plants.
The Lodge induction break and rectifier are used.

benefiting, as it seemed, from the electrification of their surroundings.

Professor Lemström accordingly suggested a connection between the remarkably flourishing development of plants in Arctic regions where the sunlight is very weak, but Northern Lights are frequent with this obvious influence of electrical discharges. The development of plants in the farthest north of Europe is known greatly to surpass that of plants growing in more southern regions, where climatic conditions are so much more favorable. The flowers there assume fresher and clearer hues and a stronger perfume, while the leaves of trees give out a stronger scent and seem better to thrive. The rich harvest given in those regions by different seeds (provided they be not destroyed by the frosts) then, is particularly remarkable.

This incidental observation induced the professor to undertake extensive experiments, taking test plants in groups and electrifying one of these, while keeping the other away from electricity. A photographic record then made of the two groups, side by side, showed, in nearly all cases, a marked improvement as the result of electrical treatment.

Electrical Apparatus Used in Preliminary Experiments in Stimulating the Growth of Plants.

The atmosphere surrounding our earth is known to be electrified and its charges are bound to play an important part in many phenomena. Atmospheric electrification thus is responsible for the formation of rain and hail, and while fine weather generally is characterized by the presence of positive electricity, a change in the weather is generally accompanied by a change in the sign of atmospheric electricity. That the electrification of the air does exert some influence on plant growth is inferred from the fact that electrified plants, under the influence of sunshine, can give off electricity from the leaves and, as the air is naturally electrified relatively to the soil, all plants are bound to be in a constant state of slow electrical discharge which is made active on the rising of the sun.

While in some sunny countries this effect being excessive, might with advantage be moderated, an artificial supply of electricity could well be made in our moderate climates with a view to increasing the rapidity and the amount of plant growth.

The experiments above referred to have been recently taken up by Sir Oliver Lodge in conjunction with his son, Mr. Lionel Lodge, Mr. J. E. Newman, a

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Two Sections of the Same Hedge Taken On the Same Day.
The lower picture shows effect of electric experiment.

of similar and under identical conditions—but without any electric wires—was provided to allow the supposed effect of electricity to be accurately gauged. The system of conductors is connected with a generator of positive electricity of a potential of about 100,000 volts and with sufficient power to keep up a constant supply of electricity at this high potential.

Direct current of about three amperes and 220 volts is generated by a dynamo driven by a two horse-power oil engine. This current traverses the primary of a large induction coil with a make and break contact interposed. From the secondary of the coil, the high tension current passes through the rectifiers and then by one pole to the system of overhead wires, the other pole being earthed. The overhead system of wires covers about nineteen and one-half acres of ground. The large poles carrying the wires were

horticulturist of Gloucester, and Mr. R. Bomford.

The method used by those experimenters consisted of maintaining a continuous high tension discharge for hours together each day over ten to eleven acres, by means of the power supplied by an oil engine and dynamo. The field to be treated was stretched over with a number of wires on poles resembling low telegraph wires, but high enough for loaded carts to pass and all the usual farming operations to go on below the wires without any hindrance. The wires used are quite thin and are supported by a few posts in long parallel spans, about thirty feet apart, being fixed to the posts by high tension insulators. A control plot

An Electrified Wheatfield.
The grain grows thick and even everywhere.

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placed in rows separated by a distance of 102 yards, the poles in a row being seventy-one yards apart. Stout telegraph wires carry the current down each row, while thin galvanized iron wires, placed about twelve yards apart, are stretched between the rows and act as discharge wires. Twenty-two poles were found sufficient to support the wire over the nineteen acres.

The transforming and rectifying apparatus is contained in a weather-tight hut on the field; the transformer is a large induction coil susceptible of continual use and its current is rectified by means of vacuum valves arranged on Sir Oliver Lodge's patented system.

One of the photographs represents the apparatus installed inside the field but for transforming the low pressure current up to the very high pressure of about 100,000 volts at which it is supplied to the discharging wires above the plants. From the right to left are seen successively, the inductive break, induction coil, high tension valves—or vacuum tubes—spark gaps and, above the wall, the insulator through which the high tension wires go out of doors. Another photo shows the post and insulator supporting the electrical discharging wires. According to the above, about one post to an acre is sufficient. A third illustration represents the very efficient type of insulator used in connection with the high tension employed.

As soon as the apparatus above described is set working, leakage immediately begins, and the charge fizzes off from the wires with a sound which is sometimes audible and a glow just visible in the dark. Those walking about below the wires can sometimes feel the effect exerted by those electric discharges on the hair of the head as a cobweb on their face. Electrification is maintained for some hours each day, but is cut off at night, it being probably only necessary to supply it during the early morning hours in summer and in spring time, or in cold cloudy weather for the whole day. In bright sunshine, electricity seems unnecessary or even harmful. The energy required to generate the electricity used in connection with those tests is very small, as although the potential is high the quantity is insignificant and the consumption of energy accordingly is comparatively immaterial. The following are a few results recorded by the experimenters showing the effect of electricity on the growth of plants.

	Bushels of Wheat per Acre		
	From the electrified	From the unelectrified	Increase
Canadian (Red Fife)	35⅛	25⅛	40 p. c.
English (White Queen)	40	31	30 p. c.

Another advantage secured by the treatment is that the electrified wheat sells at prices about seven and one-half per cent higher, baking tests showing it to produce a better baking flour.

SPARK FROM FIELD NETWORK TO EARTH.

Similar results were obtained on a good many other plants, a few of which are given in the following:

Cucumbers, 17 per cent increase.

Strawberries (five-year plants), 36 per cent increase.

Strawberries (one-year plants), 80 per cent increase, and more runners produced.

Broad beans, 15 per cent decrease, but ready for picking five days earlier.

Cabbages (spring) ready for picking ten days earlier.

Celery, 2 per cent increase.

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Small plants of tomatoes also showed a marked improvement in growth, as did plants of raspberry canes. A curious point about the latter was that the foliage and fruit of the old canes showed no difference while the new growth, particularly after the old wood was cut back, showed an enormous difference in favor of the electrified. Manurial treatment produced exactly the same effects.

Chemical analysis of the wheat submitted to the treatment showed its ears to contain a much higher percentage of dry glutens. Mangolds planted between the strawberry rows showed, on analysis, an increase in the sugar when electrified.

The results of those experiments thus show an increase of between thirty and one hundred per cent in the output of the plants treated, a shortening in the time of ripening and a striking improvement of quality. One of the most important facts borne out by Lodges' experiments is the possibility so to arrange the wire system (in virtue of the very high tensions used) that the manifold operations of agriculture are in no way interfered with.

We may thus confidently hope that the process of electrification will shortly be introduced into agricultural and horticultural practice. The corresponding increase in the use of electro-motors would incidentally educate agriculturists to a better appreciation of the good services to be derived from the use of electricity.

Dr. Max Breslauer, of the Charlottenburg Technical High School, has likewise installed (near Berlin) an experimental plant arranged on similar lines.

MILLIONS FOR A LISTENER

By C. F. CARTER

C. F. Carter began life twenty-seven years ago as a brakeman on a Western line in those picturesque days of the railroad when the link and pin coupling and hand brake were in universal use in the freight service; but presently concluding that to write about the railroad would bo more agreeable than to work upon it, went to Chicago where F. P. Dunne, afterwards famous as the creator of the immortal "Mr. Dooley," helped him to a start in a newspaper career by giving him his first assignment as a reporter. Other assignments in the ensuing twenty years

have taken him about the country from Boston to Seattle and from Sault Ste. Marie, Mich., to Brownsville, Texas. In the interval between assignments he found time to do some editorial work on Chicago and New York dailies, including four years as Sunday Editor of the Brooklyn Eagle, and to write a book for children, and to compile another book for grown-ups. For the last two years he has devoted himself to writing for the magazines and to the preparation of a history of the early days of the railroad in America.

SAMUEL NEWHOUSE, mining king, promoter, and very wide awake man of affairs, sat at his desk in his private office in Salt Lake City a few weeks ago intent upon a report of one of the numerous corporations in which he is interested, when he was startled by the discovery that a stranger was standing beside him. Having been born, brought up and educated for the bar in New York City where every man's office is his castle, to be vigilantly guarded as on a perpetual war footing, Mr. Newhouse has not yet become accustomed to discovering unannounced callers in his presence. So he glowered at the intruder as if he would annihilate him by the ferocity of his gaze.

"Mr. Newhouse, ——" began the caller.

"How did you get in here?"

"Oh, I just walked right in because I had to see you and so I didn't want to take any chances of failure. I have something to tell you. I have laid it before all the big mining men in the country, but they have all turned me down. I believe you are made of different stuff. If you will listen to me I will put you in the way of making more millions than you ever hoped to own.

"My name is Fink; Edward Fink, of Milwaukee, formerly metallurgist for the Calumet and Hecla Mining Com-

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WHERE THE FINK SMELTING PROCESS IS BEING CARRIED ON.
This plant has a capacity of 100 tons of copper ore a day.

pany. I have a new process for smelting copper ores. It is not a freak scheme, but is a scientific development of the principles underlying all successful smelting processes, which will reduce the present high cost of smelting more than half and will amount to a revolution in the smelting of certain kinds of ores, some of the biggest metallurgists and expert smelter men to the contrary, notwithstanding. Do you want to hear any more?"

Possibly Newhouse may have thought of a similar incident, not so many years ago when Alexander Graham Bell, unannounced, entered the august presence of Don Cameron, capitalist and politician, of Pennsylvania, and tried to sell him a half interest in his patent process for talking through a wire for ten thousand dollars, only to be ordered out of the office and to hear, as he departed, the clerks instructed to have "that crazy inventor" thrown out bodily if he ever dared intrude again. Newhouse also may have thought of the untold millions that have been made from "that crazy inventor's" telephone, a half interest in which was offered for ten thousand dollars. At all events hostility faded from his face and he became alert and receptive.

"Sit down, Mr. Fink. What is this process of yours?"

The interview that followed was a long one. It resulted in an agreement in which Newhouse undertook to develop and demonstrate the inventor's process, furnishing all the funds necessary to carry the experiment through to a point that would conclusively establish its success or failure. Fink was given carte blanche to build an experimental plant on a commercial scale, and W. C. Thomas, Newhouse's expert smelter man and manager, was instructed to render the inventor every possible assistance.

The site selected for the experimental smelter was at Garfield, on the dreary shores of Great Salt Lake, twenty-four miles west of Salt Lake City, where are located the great works of the American Smelting and Refining Company, including six reverberatory furnaces, four blast furnaces, ten converters and

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twenty-five roasting pots, with a capacity of two thousand tons of ore a day. The company was obliged to buy up thirty-five thousand acres surrounding the works to protect itself from suits for damages arising from the blighting fumes that pour out of the great chimney thirty feet in diameter and three hundred feet high.

Beside this enormous plant, representing an investment of five million dollars, there was erected under the direction of Inventor Fink a plant with a capacity of one hundred tons of ore a day at a cost of ten thousand dollars; that is, one-twentieth the capacity at one-five hundredth the cost.

Not until the middle of November, 1908, was the material for the plant on the ground. The weather was stormy, and every device had to be improvised; but by the first of January the plant appeared to be in working order. But it wasn't. The furnace was at first designed to burn crude oil; then it had to be changed to burn coal. Electric power could not always be obtained when it was needed, belts would slip, feeding devices balked, flues had to be relined, and the hundred and one mishaps and annoyances that always try the temper of the inventor in putting his ideas into practice kept cropping up.

At last the furnace was started. A high grade matte was produced in a few minutes, to the great gratification of Newhouse, who had watched every step with the keenest interest. But matte is an unfinished product such as is turned out by the blast furnace, of which less than half is copper, which must be subjected to further manipulation, while the Fink process was invented for the production of "blister" copper, or copper bullion. There was more tinkering and adjusting and finally, on January 16, everything was ready for the crucial test.

THE ROTARY CYLINDERS AND THE CONNECTING CHAMBER OF THE FINK SMELTER.

The fires were started and in less than one hour after the ore was first introduced into the furnace the tappets were opened and copper bullion flowed into the pots set to receive it. Part of the stream was turned into a flat mold. The

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red bar, weighing one hundred and fifty pounds, presently taken therefrom was hurried to Newhouse's office, whence it proceeded on the next east-bound train, personally conducted by Samuel Newhouse himself, to New York, where the first preliminary steps were taken for introducing the Fink process on a large scale.

To appreciate the significance of Fink's invention it should be borne in mind that while in the ten years ending with 1906 the world's consumption of copper increased 84 per cent and the consumption in the United States increased 148 per cent, some authorities have predicted that the supply of ore would be exhausted in a comparatively short time. Indeed, the production of copper in Europe, Asia, Africa and Australia is stationary or declining, while the production in the United States in 1907 was 879,241,766 pounds as compared with 917,620,000 pounds in 1906. Some of the mines in the famous Michigan copper region are already a mile deep, which renders the cost of extracting ore very high.

Any possible increase, it is now believed, must come from Nevada, Utah, Mexico, British Columbia and Alaska in the order named. The available supply would be greatly increased if enormous deposits of ore too low grade to be worked by present methods could be utilized.

More than ninety per cent of the world's copper is obtained from the ore by smelting in a blast or reverberatory furnace. Some of the more complex varieties of ore require roasting or other preliminary treatment before they can be handled in the furnace. First of all, they must be concentrated by milling and washing out the greater part of the gangue, or worthless material in which the metal is contained. The minute particles into which the copper and the gold and silver usually associated with the red metal are divided in the milling process along with the gangue, are so light that they float in the molten mass in the furnace until they are collected by the matte which carries them down to the botton of the furnace where they can be drawn off. Matte is a mixture of metallic sulphides, of which usually about forty per cent is copper and which

A FRONT VIEW OF THE FINK ONE HUNDRED TON SMELTER.

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also contains the gold and silver, which must be further treated to recover the metals it contains. Altogether, smelting is both difficult and expensive.

For example, at the copper mines at Ducktown, Tenn., which produce a low grade ore, the cost of production in 1907 was 11.79 cents per pound, of which 5.016 cents, or nearly half, was charged to the blast furnace. At Boundary Creek, B. C., the cost was $1.60 a ton; in the Rocky Mountain region it averaged about $3.50 a ton. In 1906 it cost the Boston Consolidated Company $1.78 a ton for milling, smelting and refining ore which yielded $2.83 in copper and 20 cents in gold and silver per ton. At the Utah Consolidated works the average yield of copper in 1907 was fifty pounds per ton. As the market price of copper ranges around 13 to 14 cents a pound it can readily be seen that there are not exactly sensational profits in the copper business, particularly as in the present state of the art the metal can only be produced in extremely costly plants which, to be profitable, must be operated continually on a large scale.

In fact the copper business is distinctly a millionaire's game. The great smelters, representing enormous investments, are in the hands of a very few, who are thus able to fix a price for the treatment of ores which has a tendency to freeze out the small capitalist and put the mines, too, in the hands of a few. What concerns the public more directly is the need of a cheaper method of treatment which will make it possible to handle the low grade ores which would afford a very large source of supply if they only could be worked profitably.

This need the Fink process is designed to meet. It is not surprising to find that many distinguished metallurgists declared it was impracticable, for most of the methods in use today were said by the highest authorities only a few years ago to be absolutely impossible. For instance Dr. E. D. Peters, professor of metallurgy at Harvard, a few years ago declared it was impossible to enrich matte by running it through the furnace more than once. But it is done today, and the process has done much to make the smelting of pyritic ores a success. Recently it was discovered that the Bessemer process for converting pig iron into steel by forcing compressed air through a column of molten iron could be applied to copper smelting and "Bessemerizing" has now become quite common.

The Fink process is not intended to be applied in the treatment of all sorts of ores but to meet special conditions, as were the new methods just mentioned. The greatest difficulty in the smelting of concentrates has been that a great deal of the powdered ore was blown out of the furnace by the tremendous blast forced in at the tuyeres before it could settle down into the lower part of the furnace, the only place it could be melted. To overcome this difficulty a great deal of time and money have been spent on experiments for preparing the fine ore, or concentrates, for the blast furnace. The usual idea was to make the fine dust into briquettes too heavy to be blown out. This, however, was progressing backwards. Not only was an extra operation required which was expensive and wasteful, but there was further loss in the furnace. It is easier to melt a handful of snow than a lump of ice of the same weight. Fine concentrates, made by grinding and subsequent washing out of worthless material are ideal for rapid smelting if they only could be handled.

To smelt such a product cheaply it was necessary to break away from established methods and change the furnace as well as the method of handling the ore so as to take advantage of its fineness without danger of losing too much of it in flue dust.

Another and most important consideration is the amount of fuel consumed. The great reverberatory furnaces at Garfield, which have a capacity of two hundred and fifty tons of ore a day each, burn each fifty tons of coal a day. The Fink furnace of two-fifths the capacity burns only two tons. This enormous economy is effected by utilizing the sulphur in the ore. In ordinary smelting the sulphur is a nuisance. As much as possible is removed by a preliminary roasting before the ore goes into the furnace; otherwise so much would go into the matte that it would

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be rendered practically worthless for commercial use.

Now sulphur is a fuel, and if given a fair chance will burn and give off heat like good coal. All the sulphur driven off in the preliminary roasting, therefore, is so much good money thrown away. The only place where sulphur can be utilized as fuel is in the range of the blast from the tuyeres. Above the tuyere zone it volatilizes and passes out of the chimney. The ore upon reaching the zone of fusion near the tuyeres melts immediately and runs out of the furnace so quickly that there is no chance to burn out much of the waste material and thus "enrich the matte," in the language of the smelter man.

It occurred to Fink that if it were possible to retain the molten matte in the tuyere zone for any desired time it would be possible to produce copper bullion in a single operation instead of a matte requiring further treatment. To accomplish this a furnace quite different from any in use was required.

In the reverberatory furnace the fuel is burned on a grate at one end of the furnace, the flame only entering that part containing the ore, the heat being deflected downward and thus concentrated on the charge of ore.

In order to utilize the full value of the fuel it should be burned where the heat is required, which is in the furnace itself; and, as in the fusion of the ore, the maximum of efficiency is obtained when the coal is ground to powder; for then the combustion is practically instantaneous. Blast furnaces require coke, which is not only more expensive than coal, but is not always available.

THE ROTARY CYLINDERS AND CONNECTING CHAMBERS AT CLOSE VIEW.

In the Fink furnace coal, oil, charcoal or sawdust may be used in combination with the sulphur in the ores. Often there is enough sulphur to supply nearly all the heat required, once the smelting operation is under way.

The Fink furnace at Garfield consists of two barrel shaped receptacles nine feet long and nine feet in diameter which when in use revolve at different speeds and in opposite directions. Only twenty-five horse-power and a force of fifteen men are required to operate the plant. The powdered fuel is blown into

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one cylinder and the flame is returned into the second. While the charge in the first furnace is being smelted and refined the charge in the second is roasting, the heat being supplied by the gases escaping from the first furnace.

Fresh ore is fed into the furnace either continuously or intermittently as circumstances may require. Being plunged at once into the bath of molten slag and matte the fine particles fuse instantly, so that none are left to escape as flue dust. The revolving of the furnace keeps the mass constantly stirred up which very materially hastens the smelting and makes possible the operation of Bessemerizing. A permanent refractory lining is used in the cylinders instead of the less durable silica lining of the ordinary converter.

The great point about the Fink furnace is that small plants can be operated economically and it can be run intermittently, whereas a blast furnace must be operated continuously. Blast furnaces have a trick of "freezing up"; that is, filling up with a mass of material that had half fused and then solidified, which must be blasted out, often at a cost of five thousand dollars. If such mishap befalls the Fink furnace it can be thawed out in an hour without difficulty.

CONCEALING LIGHTS TO SAVE EYES

By DANIEL HIRCHELL

In an ordinary room, without sunlight, the brightness of the daylight commonly runs as low as 1/10 candle-power per square inch. The brightness of artificial lights is much greater than this, which accounts for the injurious effects they produce on the eyes. J. E. Woodwell discussed this subject in a paper before the Illuminating Engineering Society of Philadelphia, stating that the best illumination is a diffused light of from 2 10 to 1 10 candle-power per inch.

THERE is a biblical injunction against hiding our "light under a bushel." Yet it is probable that in a short time nearly every one who has gas or electricity for lighting will be literally covering the source of light with a metal shade that looks very much like a small bushel measure. For several years, lighting experts and more particularly specialists in eye troubles have decried the evil effects upon the eye of the direct rays from our modern brilliant light sources. This has been made more evident by the introduction and general use of the new high candle-power metallic filament incandescent lamps. There have, therefore, been many attempts to devise a method of interior illumination by which the rays are reflected once at least before reaching the eye.

There is a considerable number of installations in which this "indirect illumination" is applied in different ways, the most successful heretofore being that in

A Tastefully Arranged Room Illuminated by the New System of Concealed Lights.

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which the light is hidden behind brackets around the edge of the room and reflected towards the ceiling. It has been very limited in application owing to the loss, or absorption, of light by the reflecting surfaces, but where the expense is not considered, very pleasing results were produced. Recent developments have been made that probably mark an epoch in interior lighting and will make indirect illumination a very general system. In order to make this method commercially available, that is, bring it within the reach of the man of ordinary means two things were necessary. First, a light of high candle-power at low cost. Second, a reflecting surface that would give the first reflection of light upward without material loss.

Where it was used the necessary candle-power and economy are found in using the higher grade incandescent mantles. During the past year a new type of electric lamp having its filament made of the rare metal, tungsten, has been put on the market, and where electricity is used it proves an ideal source of light for this system. It is an interesting fact that the introduction of the tungsten lamp which made indirect lighting almost a necessity is one of the factors that made it possible. With this lamp the same amount of electric energy will produce about three times the light that would be produced by the old style carbon filament lamp. Electrical energy is measured in watts, a watt representing 1/746 part of a horse-power. It takes about 3½ watts of energy to produce one candle-power of light with the carbon lamp. With the tungsten lamp it requires about 1¼ watts to produce a candle-power. Consequently, for the same expenditure for current for lighting we can get three times as much light with the tungsten lamp as with the carbon lamp, and can thus economically use a brighter light and have it reflected before reaching the eye.

The reflecting surface of the reflector surrounding the lamp or mantle offers no difficulties, that problem having been solved already after many years of struggle and experiment, and marketed for several years under a somewhat misleading trade name. Reflectors of this type consist of a single piece of blown glass coated on the outside with pure silver, and giving a reflection of remarkably high efficiency. The silvering is protected on the outside by coats of elastic enamel. Much greater efficiency and durability is claimed by the maker than is obtained by ordinary mirror coatings. The reflector used has of course a vital influence on the results in the long run. The necessity for efficiency and durability is evident. It is equally important that the reflector be capable of being molded so as to be uniform and correct in design and compact in form, and to permit of easy and thorough cleaning.

A Bed-Chamber in Which the Concealed Lights Are Used.

The design or shape of the reflector also has an important bearing on the efficiency and on the effect produced in the room. The correct shape of this inverted reflector for throwing the rays of light to the ceiling without shadows, as adopted, has been the result of considerable calculation and experiment. The perfected design is of a bell shape having

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A LIVING ROOM FIFTEEN BY THIRTY FEET ILLUMINATED BY CONCEALED LIGHTS.

peculiar spiral corrugations. The exposed glass surface is fire glazed and so is easily cleaned with a soft cloth.

The indirect lighting units worked out consist of this scientifically correct reflector, fitting in a spun brass casing. On gas fixtures this casing rests on the base of the mantle like a globe. On electric fixtures it can either be suspended by chains or supported from below, as in the case of gas fixtures. It is evident that an infinite variety of ornamental designs can be worked out embodying these units, and judging from the great interest shown, fixture manufacturers in the near future will be designing fixtures for use with this method of illumination.

These lighting units can be easily installed on gas or electric chandeliers already in use. Unless the chandelier arms are very heavy, it can be applied on any electric fixture where the sockets are pendant. The arms do not cast annoying shadows on the ceiling, since the corrugations cause the light to come from so many directions.

The fixtures should be at or near the center of the room, though side lights can and have been used with satisfactory results. Light colored walls are not essential as most of the light is directed to the ceiling. The units can be arranged in a variety of ways. Only a few simple designs of fixtures embodying them are here shown. The fixtures can be installed in single units or multiples, either electric, gas or combinations of both, and it is practical to illuminate in this way, not only residence, but halls and auditoriums.

Of course this system of illumination is not as successful with beamed ceilings or those of dark tint, but in the majority of instances the ceilings are light and the conditions favorable. There are at present many experimental installations of this system in use among professional and business men in their residences and offices. Without exception, they are enthusiastic in its praise, and are so im-

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pressed with the eye-comfort derived from its use, that they would go back to the old system of lighting only under protest. Direct light rays from the filament of the lamp striking the eye cause much trouble and discomfort. We all know that a rough paper which partially breaks up these rays by diffuse reflection is far preferable to the glazed surface so commonly used in our magazines. The rays of light striking first the reflecting surface of the ceiling lose their injurious effect and the eye-comfort experienced by this method is very noticeable. One is enabled to see better. While it is true that there is a loss of light, another factor enters to overbalance this. The more easily details can be seen, the more effective is the illumination. When there is a bright naked lamp in front of the eye, the pupils contract and, therefore, the eye takes in less of the light and the things that are illuminated are not seen as clearly as with less light and a wide-open pupil. Hence the fact that there may be less light with indirect illumination does not mean that we see less clearly, but on the contrary, we really see better.

The cost of installation and maintenance does not much exceed that of the ordinary methods now in vogue. The benefits and comfort are unquestionably so far superior that to many the cost would not be a matter of consideration. A fixture of one reflector and one 100-watt tungsten lamp or a good gas mantle burner gives a beautiful illumination in a room up to fifteen feet square. This consumption makes the cost very reasonable, being at the cost of gas or electric current of from a half to one cent per hour. This is probably not more than it costs in the majority of instances to illuminate such rooms by the present methods.

The Witching Hour

'Tis just the hour
When pleasure, like the midnight flower
That scorns the eye of vulgar light,
Begins to bloom for sons of night
And maids who love the moon.

—MOORE.

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MATCHING COLORS WITHOUT SAMPLES

By JEAN MITCHELL

A NEW invention, which makes possible the exact description of colors of all kinds and shades, without samples, and by means of numbers only, has recently been produced by an American. It promises an extraordinary help in a field where help has been sorely needed, and so successful is it that colors, in the minutest variations, may now be matched by mail, by wire, or by any other method of communication.

The need of a fixed standard in measuring colors—a standard influenced neither by atmospheric conditions nor by time, has long been felt both in laboratories and in large industrial concerns and there can be little doubt that a new colorimeter, invented by Frederic E. Ives,

THIS MACHINE OFFERS A FIXED STANDARD FOR COMPARING SHADES OF COLORS.

will supply this need. Its usefulness has been demonstrated in Boston, where it has been installed for several months and observed by scientists.

The Ives colorimeter has solved the problem of keeping a record of colors by means of a standard and by the taking of actual measurements. It is a direct vision instrument. At one end of the machine, which is practically a rectangular box, three by four by twenty inches, are three nearly juxtaposed rectangular openings, covered by screens of the colors red, green and blue respectively. All have adjustable shutters. In the middle of the instrument is a field lens in connection with a wedge prism so located that the light from the color screens passes through only one-half of the lens. At this point there is also what is called an optical mixing wheel and a small electric motor. This wheel is made of convex lenses, and its purpose is optically to mix to the eye all colors within the field of the instrument. It is run by the motor and the speed regulated by a small rheostat on the base board. It is a well known fact that the eye retains any impression for an instant after receiving it, and this faculty is called the persistence of vision. Independent colors when passed in rapid succession before the eye, therefore become so perfectly mixed that a single even color is obtained. The mixing wheel is for the purpose of accomplishing this effect.

For purposes of comparison, a clear opening is located near those covered by the color screens. This aperture admits light which is bent into the axis over one-half of the field by a wedge prism, and spread across it by the optical mixing wheel just as the three colors mentioned are. At the other end of the instrument is the eye piece.

That the instrument may not be subject to change according to the condition of day light, the two fields are exactly matched at the outset. This can be done very accurately and rapidly after a little practice. The green shutter is opened wide—on the fixed scale of the instru-

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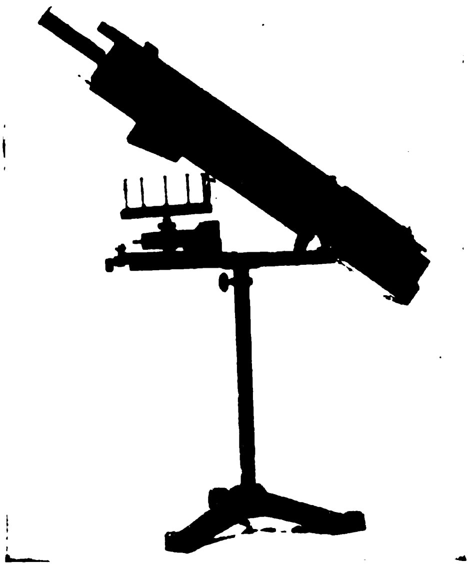

THE BODY TURNED UP TO EXPOSE THE OPTICAL MIXING WHEEL AND SMALL ELECTRIC MOTORS.

ment this is 100—and the red and blue shutters are opened till the two fields exactly match. It is sometimes necessary to readjust the shutter of the clear aperture in order to make the fields match in luminosity as well as in hue. The necessity of matching the fields at the outset makes more accurate and delicate work possible, as the degree of illumination is not always the same, nor have the color screens the same relative value for all eyes.

When the two fields have been matched, it is an easy matter to match any color seen through the clear aperture by means of an adjustment of the red, green and blue shutters, and to record the color so measured in terms of three definite spectrum hues, recorded by three numbers on the instrument's scales. For instance, a shade of purple may be registered as Red 50, Green 5, Blue 80, or, if the numbers are always set down in the same order, it will be sufficient to say merely, 50, 5, 80.

By varying the openings of the shutters for the three colors, any color used in art or by manufacturers, can be accurately matched, recorded by three numbers, and easily reproduced at any time, simply by resetting the shutters to the same scale-readings and directing it to a background of standard white. The "standard" white background which has been adopted, is a sheet of dense opal glass backed by a sheet of white paper. If the colorimeter is properly set, the light from this ground—light from the sky, diffusely reflected—will fill both sides of the divided field of the colorimeter evenly when the optical mixing wheel is rapidly revolved by the electric motor.

The red, green and blue color screens show no trace of change after long exposure to summer sunlight, nor is the color changeable by accident as in an accidental shift in the spectroscopic instrument.

There is little doubt that since one instrument has been successful, others can be made, since the only possibility of variation is a difference in the uniformity of the focal length or of the lenses and a difference here can be remedied.

With the colorimeter in its present stage of development it will be possible

PERSPECTIVE VIEW OF THE INSTRUMENT AS IN USE

to keep accurate records of shades and of luminosity and so to reproduce any registered color at any time regardless of the effect time or exposure may have had upon the original production. It should prove invaluable to manufacturers, make possible more complete tests in color blindness and open a wide range of experiments in laboratories.

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ENGINEERING PROGRESS

SHIELD TO PROTECT LINEMEN'S LIVES

A PROTECTIVE shield has been devised for the use of linemen when working on high tension wires up to 7,500 volts. These shields have been employed to advantage and without danger on circuits carrying as high as 10,000 volts, the shields being tested in water up to 30,000 volts. Each shield consists of rubber insulation in the form of a trough, with rubber handles attached to the outside of each one for the use of the linemen in gripping the shield when placing the same over an insulator, the shield always coming between his hands and the wire.

A hard rubber slip ring is provided, having an opening of half an inch or more to admit the wire, one of these rubber rings passing over each end of the shield and clamping it firmly to the wire so as to prevent it from dislodging. The accompanying illustration showing the shields in service was taken with the full power of 4,600 volts, three phase, on the three wires covered by this rubber insulation. The current was not shut off during any of the time the work was under way. The linemen cut the insulation from the live wire of 4,600 volts with a knife held in the bare hand, without any danger from the high tension circuit. As the wireman stands or leans on the three shields there is no way for the current to ground, or make a short circuit through his body with one of the other wires.

LINEMEN USING SHIELDS AS PROTECTION AGAINST LIVE WIRES.

It is necessary in the construction of these protective devices that only pure Para rubber be used, as reclaimed rubber often contains small metallic particles which interfere with its insulating qualities.

AUTO AS ELECTRIC LIGHT GENERATOR

AT the time of the recent Vanderbilt Cup races, on Long Island, many of the observers arrived at the course in automobiles some hours before daylight, in order to secure good positions for viewing the racing machines. One of the great automobile companies secured parking space for owners of their cars, and illuminated it through the night in a very effective manner.

A four-cylinder roadster was run into the space. One side of the rear axle was jacked up and securely blocked, the tire removed from the left wheel and a belt carried around it to an electric light dynamo. The right rear wheel remained stationary by reason of the differential in the rear axle which permits the two wheels to revolve independently of each other.

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RUNNING AN AUTOMOBILE TO GENERATE POWER FOR ELECTRIC LIGHTS.

The dynamo was run at two thousand revolutions per minute and generated current for forty-eight sixteen candle-power lamps, which were suspended around the space and in the supply and mechanics' tents. The arrangement gave full satisfaction during the five hours it was in operation, and attracted much notice and favorable comment for its simplicity and efficiency.

CAR WITHOUT DROP WINDOW FRAMES

SOME of the English railway coaches have no wooden frames to the drop windows in the doors, the plate-glass being only rounded at the edges. For this unusual method the North-Eastern Railway claims that one of the advantages of having a window without frames is the saving effected in making and keeping in repair the frames; but the chief feature is that they prevent all rattling and noise which an ordinary window makes, and for this reason are considered a great improvement on the windows fitted in frames.

The compartments are each provided with a balanced glazed drop light five feet wide with the customary glazed light above. There are no side doors, as there are on most English railway coaches, entrance being by the end vestibules only. By this means the body of vehicle may be built to the full width available as there are no projecting handles to provide for. The body frame is greatly simplified, the danger of persons falling through accidentally opened doors is quite obviated and the appearance of the train is much enhanced. This vehicle is an example of those used for the through trains between Hull and Liverpool, and it is noteworthy that these, together with the trains running between Newcastle and Liverpool, were the first complete trains designed in England to give uniformity of external appearance with side doors at the vestibules only. A similar practice has been adopted in the latest trains in the West Coast service but without the other unique features of the North-Eastern practice.

AN ENGLISH CAR WITH UNPROTECTED PLATE GLASS WINDOWS.

NEW APPARATUS FOR WATER-FINDING

THE problem of the divining rod has been taken up again of recent years. An apparatus, similar in its outside appearance to an ordinary magnetic compass, has been used successfully by Herr Adolf Schmid of Berne, Switzerland, and is likely to assume a considerable practical importance.

This apparatus, which has been re-

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cently submitted to the French Academy of Science, is an inexpensive outfit which is ready for operation at a moment's notice. While being operated by anybody, it is bound to give particularly valuable results at the hands of persons possessing some notions of hydrography or the science of water distribution.

The apparatus is based on the principle of the Daguin acoustele or sound

USING THE WATER-FINDING INSTRUMENT.

analyser. It has been utilized in an extensive set of tests by Monsieur Diénart, an engineer connected with the water service of the French capital.

The Daguin acoustele is simply a hearing funnel provided in its interior, towards the bottom, with a small cone with its basis turned toward the narrow end of the funnel. The instrument is enclosed in a special casing, preventing the outside air from producing any noise liable to interfere with the operation of the instrument by covering the noises perceived by the experimenter.

In order to use the apparatus, a hole is dug in the ground and the instrument placed in the water of a transportable tank, is fitted into that hole. When the ends of the India rubber tubes are then applied to the ears, the noise, characteristic of the passage of underground water, is perceived after about five minutes' listening whenever the site is on top of some water course. This noise is a continuous humming, comparable to the roaring of the wind blowing in the woods and is particularly intense if the underground water falls into a gallery. The air of the latter, in fact, reinforces, by its resonance, the sound waves given out by the watercourse.

BAROMETER OF MAMMOTH SIZE

AT the exhibition of Faenza, Italy, which is primarily devoted to the memory of Evangelista Torricelli, it was intended to erect to that celebrated physicist—to whom is due the discovery of air pressure, a monument in the shape of a mammoth barometer. The managers desired a water-barometer susceptible of being read from the level ground to be constructed.

This task involved a number of practical difficulties. In the first place, it was found impossible to use water as barometer liquid, because of the variations in vapor tension which, with variable temperature, would have depressed the liquid column by irregular amounts.

Olive oil therefore seemed to constitute the most suitable material: with a specific weight of .195, the column of an olive oil barometer—corresponding to normal air pressure—would be upwards of 37

HUGE BAROMETER AT EXHIBITION IN ITALY.

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feet in height, while the variation corresponding to one inch of mercury would be as much as 14.35 inches, thus being nearly fifteen times as great.

ELECTRICAL RECORDING TARGET

AN Australian electrician, Mr. A. M. Rose, has designed a recording target which would seem to increase the accuracy of records and reducing the cost of target recording apparatus.

In the arrangement used for recording single shots, the target takes the shape of a roll of paper wound up from drum to drum, while passing under a number of small spring fingers connected with a continuous resistance, one end of which communicates with the recorder at the firing point, while the other end is connected up to a common terminal running throughout the row of fingers.

After each shot the target is wound over the drum and wherever there is a bullet hole, one or more fingers is allowed to drop, thus completing the recording circuit and actuating two relays.

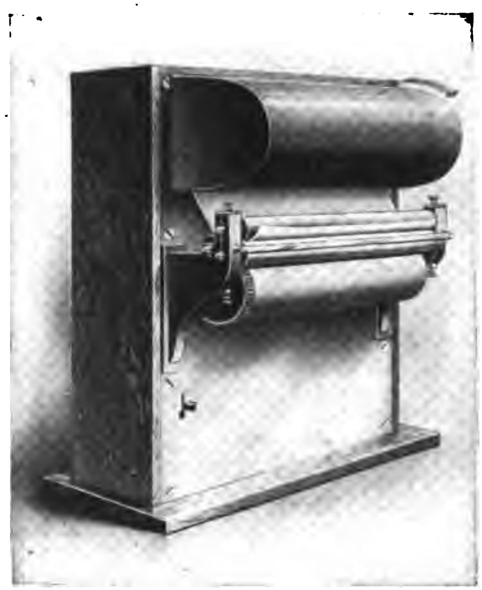
By closing local circuits through electro-magnets, the latter simultaneously arrest the target and the recording drum.

Now, according to this arrangement, the current intensity obviously depends on the vertical position of the bullet hole with regard to the keyboard. The recording pencil at the firing point is accordingly pulled up by the solenoid to a level depending on the current intensity and, therefore, corresponding with the accurate vertical position of the bullet hole.

By then pressing a key, the operator momentarily closes the circuit of an electro-magnet inside the drum, causing the pencil to strike a roll of paper wound over the drum, after which it interrupts the main circuit, opening the local circuits and releasing the drums. At the same time each shot is registered, the positions of the gauge points are automatically indicated so as to allow the record to be referred to a well defined basis. This is effected by an auxiliary wire connected with a row of keys and a recording magnet and pencil. The whole of this operation, apart from the pressing of the key thus is entirely automatic.

The same apparatus could be used for registering volley firing, but for the possibility of several holes falling on the same vertical line. The inventor has, therefore, designed a special arrangement for rapid or company firing.

Instead of connecting the keyboard used for this purpose with a continual resistance, each contact lever is connected with a separate wire running as far as



TARGET WHICH KEEPS SHOOTING SCORE BY MEANS OF ELECTRICITY.

the firing point. At the latter is arranged a row of marking pencils each carried by a lever, the outer end of which is acted on by a small electro-magnet inserted into the circuit of one of those wires. By a suitable arrangement the distances between the centers of those levers can be reduced to about one-sixteenth of an inch.

Now, as the target is wound continuously upon the drum, the fingers are allowed to drop into the holes of the paper, closing their respective circuits and thus producing at the firing point, a record of each shot. The relative position of the shots is likewise ascertained by means of the gauge points provided in the left-hand top and right-hand bottom corners, respectively.

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The Merry Widow

A MAN whose wife was extremely jealous planned a pleasant surprise for her in the form of a trip to New York to see "The Merry Widow," and wrote a friend in the city to let him know the earliest date for which he could secure seats. The next day when he was away from home the following telegram was delivered there, addressed to him. but opened by his wife:

"Nothing doing with the widow until the tenth. Will that suit you?"

Explanations were demanded.—*Lippincott's.*

Various Methods

HEWITT—"I have been pinched for money lately."

JEWETT—"Well, women have different ways of getting it. My wife kisses me when she wants any."—*Chicago Journal.*

Nearer the End

"IF I were younger," said the rich old man, "I believe I might win you for my wife."

"Yes," replied the cold beauty, dreamily considering his sixty-five years; "or, say, fifteen years older."—*Philadelphia Press.*

Up to Him

"DO YOU think you can manage with my salary of $12 a week, darling?" he asked, after she had said yes.

"I'll try, Jack," replied she. "But what will you do?"—*Universalist Leader.*

A Compromise

CORPULENT SUITOR (on his knees)—"If you will not accept my offer, at least help me up."—*Meggendorfer Blaetter.*

The Reason

GOD made woman beautiful and unreasonable so that she would love man.—*Life.*

Dust

A SIGN hung in a conspicuous place in a store in Lawrence reads:

"Man is made of dust. Dust settles. Are you a man?"—*Boston Record.*

Lese-majesty

ALPINE HOTEL MANAGER (to the man who has the telescope for hire)—"The Kaiser is coming here tomorrow. Be careful to say nothing to him about the majesty of the mountains."—*Meggendorfer Blaetter.*

Advice

"YOU'S got to put a certain amount of dependence on yohsef," said Uncle Eben. "De man dat goes aroun' lookin' foh too much advice is liable to find hissef in de position of de gemman dat gits so interested readin' de time table dat he misses his train."—*Washington Star.*

He Knew

SENTIMENTAL YOUNG LADY—"Ah Professor! what would this old oak say if it could talk?"

PROFESSOR—"It would say, 'I am an elm.'"—*Fliegende Blaetter.*

Letting the Cat Out

"SAY, grandpa, make a noise like a frog," coaxed little Tommy.

"What for, my son?"

"Why, papa says that when you croak we'll get five thousand dollars."—*Success.*

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What He Wanted

Mr. Hayrix (in swell restaurant)—Kin I git my dinner here, mister?

Waiter—Certainly, sir. Will you have table d'hote or à la carte?

Mr. Hayrix—Well, yew may gimme a leetle of both—an' be shore an' put plenty uv gravy on it.—*Arkansas Traveler.*

The Strenuous Life

A young girl of far Albuquerque,
Aspired to be hired as a clurque;
But returned to her ma,
As soon as she sa
Like everything else, it was wurque!

—*Reprinted from February Technical World.*

Any More?

Your knowledge of fair Albuquerque,
At the least seems to be rather muerque.
But if I complain,
I expect you'll maintain,
It's the way they pronounce it in Tuerque.

He Heard Nothing

A gentleman undertook to purchase a waist for his wife.

"What bust?" inquired the saleswoman.

"Why, I didn't hear anything."—*Everybody's.*

Back in the Woods

"Is there any arbutus around here?"

"No; nothin' but rheumatics. We're pretty healthy this spring."—*Harvard Lampoon.*

Fully Explained

Old Lady (rather deaf)—"Are you any relation to a Mr. Green?"

Green—"I am Mr. Green."

Old Lady—"Ah! Then that explains the extraordinary resemblance."—*Pittsburg Observer.*

Justifed Alarm

Very much excited and out of breath, a young man who could not have been married very long rushed up to an attendant at one of the city hospitals and inquired after Mrs. Brown, explaining between breaths that it was his wife whom he felt anxious about.

The attendant looked at the register and replied there was no Mrs. Brown in the hospital.

"Oh! Good heavens! Don't keep me waiting in this manner," said the excited young man. "I must know how she is."

"Well, she isn't here," again said the attendant.

"She must be," broke in the visitor, "for here is a note I found on the kitchen table when I came home from work."

The note read:

"Dear Jack: Have gone to have my kimono cut out.—Annie."—*The Pilgrim.*

Woman

Oh, woman, you are charming,
And poets long have sung
Their sweetest verses to you
In every written tongue;
But none of them has ever
Told why it is that you
Will always leave a street-car
.ot dne gnorW.—*Success.*

Revised Version

Jack (proudly)—We learned a new commandment in Sunday school today.

Doting Parent—Yes, dearie, and what was it?

Jack—Thou shalt not kick a duckery.—*National Home Magazine.*

Candid

A summer visitor who was trying a horse, the property of a New Hampshire farmer, with a view to buying him, noticed that after driving a few miles the animal pulled very hard, requiring a firm hand and constant watching. "Do you think this is just the horse for a lady to drive?" he inquired doubtfully.

"Well," answered the owner, with an air of great candor, "I must say I shouldn't really want to be the husband of the woman who could drive that horse."—*Christian Register.*

SCIENCE AND INVENTION

ROADS FROM CLOVER AND SAWDUST

AN experiment in road-making in a sandy country has proved successful during the past summer near Princeton, Minn. The road was made by mixing freshly cut yellow clover and rye straw with the sand base, the idea being to convert the sand into a vegetable loam so that it may be worked into a road. The highway has been in use six months and is highly praised by the farmers who use it.

This idea in road-making was the conception of George W. Cooley, state highway engineer for Minnesota. In some portions of the state, the sandy nature of the soil makes good roads out of the question without the importation of surfacing materials. In most cases this is impossible on account of the expense. Mr. Cooley evolved the idea of changing the character of the soil along the highway by mingling it with vegetable matter. Near Princeton clover was used, and on a shorter stretch, sawdust was used as the ingredient.

Experimental Road Near Princeton, Minn., Built of Sand and Clover.

For the clover road Mr. Cooley had the road graded, and planted yellow clover and rye on the right of way, except for a driveway of twenty feet. The rye was planted with the clover to protect the latter during the hot summer. Rye straw was thrown on the road and worked into the sand by passing teams. Several times during the summer the clover was cut and also thrown upon the road. This was well worked into the sand and has partly changed the character of the soil.

Four inches of sawdust from a saw mill was spread over a quarter of a mile of road near Cambridge and worked into the sand in a similar manner. The top of the roadway was frequently worked so as to prevent ruts and the sawdust was well mixed with the sand. This is rotting and is gradually making it possible to work the road as though it were made of loam.

A CURIOUS GERMAN BEE-GARDEN

THE bee garden illustrated herewith was originated and constructed by a simple school teacher in a small German town, where it is, of course, an attraction. As can be seen, the bees are housed not in the usual hives but in finely modeled buildings, all of which are different from one another. It is a fact that bees always return to the hive to which they belong,

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Bee-Hive Built Like a Habitation of Man.

being attracted by the color, form, or shape of the opening. To facilitate this still more the schoolmaster made the hives quite different. They represent buildings in miniature, such as a castle, an inn, a residence, a cottage, a shelter for a military sentry, a windmill and models of animals—a bear standing up, an elephant and a lion. There is of course an opening somewhere hidden in the skin of the beasts, also in the houses, to obtain access to the honey. The little buildings have all the details that make them look like real houses, such as windows, doors, curtains, and steps, and the animals are also cleverly executed. They are of larger size than the man who built them. Models other than are shown here are in course of construction and the school teacher intends steadily to increase his collection. He is building at present a cave with dwarfs. The whole garden is surrounded by a high railing broken by an artistic portal bearing the designation "Bee-garden."

NEW CLEANER FOR BOILER FLUE.

A MACHINE that planes all scales, rust, soot and dirt from the interior of tubular boiler flues without occasioning any interruption in the operation of the boiler is likely to interest those who appreciate how desirable it is to keep the flues of boilers free from such foreign matter. The true importance of so doing is often lost sight of in comparison with the trouble of thoroughly cleaning when that entails the shutting down of the boiler, because it is not commonly realized how great is the loss of efficiency when the flues are dirty. The accumulated material on the flues is a poor conductor of heat, and it is stated that 1-32 inch of soot will increase the amount of heat required to evaporate a given amount of water, 15 per cent, while ¼ inch of soot will require 70 per cent more heat.

The machine illustrated and recently patented by a company in New York City is one which is claimed to do just what was stated above. Its operation as applied to the particularly difficult problem of cleaning upright boilers is especially interesting, for it is believed to be the first practical method of cleaning such boilers thoroughly.

A Miniature Elephant That "Houses" Bees.

Fig. 1 shows an interrupted compressed view of the complete apparatus. The frame is made up of separable sections of one-inch tubing connected by couplings, including a handle, a long straight slotted tube and a curved tube terminating in a spider at D. The straight section of the tube carries a sliding handle A, an adjustable stop B and an adjustable supporting leg C, which is

Fig. 1. An Interrupted Compressed View of the New Boiler Flue Cleaner.

pivoted so that the apparatus may be folded and more easily carried when taken apart. When in use the supporting leg C rests on the floor just outside of the firebox, the curved part of the tube is in the furnace and the spider D is pressed against the lower end of the flue. The middle section varies in length according to the length of flues to be cleaned. Through the slot on the side the handle A is connected by a screw to a cylindrical block approximately fitting the inside of the pipe. This block is connected by two steel tapes, portions of which are shown in various places, reaching through the forward end to the cleaner head.

An enlarged detail of the head, represented in a section of flue, is given in Fig. 2. It is this head which does the actual work of cleaning the flue, and is the essential feature of the apparatus. The remainder of the parts are simply means of sliding the head up and down through the flue. The head consists of pivoted blades with cutting edges at their free ends which are disposed at such an angle that they have no tendency to cut into the metal of the flues, and in fact are not sharp enough for that, but nevertheless get back of and in under the incrusted matter, removing it after the manner of a chisel. As the head is pushed upward through the flue the blades yield, but on the downward movement the springs which tend to hold the blades outward cause them to take hold.

Fig. 2. The Head as It Appears Inside of the Flue.

Aside from the rapidity and thoroughness of this method of cleaning—it is claimed to take only about twenty minutes to clean the average upright boiler—the principal advantage is that it is not necessary to draw the fires, and it may even be possible to dispense with banking them.

Horizontal boilers can be as readily cleaned with an even simpler apparatus, based on the same principle. The head in such cases is simply attached to a one-half-inch rod which is made in sections for convenience in transporting, and is pushed directly back and forth through the flues until they are free of incrusted material.

STEEL TANK FALLS THROUGH CONCRETE BUILDING

A PECULIAR accident, the cause of which is still a mystery, happened to a new reinforced concrete building in St. Joseph, Mo., when a steel tank partially full of water, weighing 120 tons, crashed through the roof, and through each of the nine concrete floors, to the ground, a distance of 110 feet.

The building had been erected with a special view to strength and durability, by one of the best known contracting firms in the Middle West, and was intended for use as a wholesale dry goods house. Every precaution, as was supposed, had been taken against such an accident. In computing the carrying power of the columns, an additional weight of 200 tons had been allowed for the water tank, which was to supply water to the automatic fire extinguishing system.

The unit system of construction had been applied. Concrete columns, reinforced with steel rods, extended from

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foundation to roof throughout the building.

On the day of the accident an agent of an automatic sprinkling system was on the work to test the appliances. He turned on the water, and, when the tank was about two-thirds full, there was a loud cracking noise. The agent noticed that the tank had tilted slightly from its upright position, and gave the alarm; but an instant later the great reservoir had ripped its way through the steel-and-concrete support, and was on its way of destruction toward the earth.

No one interested in the building will admit to any theories as to the cause of the accident, but an inquiry is now under way which may solve the mystery. Sections of the steel and concrete have been sent to Chicago and St. Louis, there to be scientifically examined, with a view to the detection of possible flaws. None but high carbon steel was ordered for the structure, but it is thought possible that some soft steel may have found its way into the consignments.

The Building Through Which Huge Tank Fell.

This curious accident recalls the collapse of the partially completed concrete Hotel Bixby, at Long Beach, Cal., in the fall of 1906.

Two-Seated Runabout Auto for Children

AUTOMOBILE FOR CHILDREN

An automobile now being built by an Eastern company for the young folks is of such simple design that any intelligent boy or girl of eight years or more can operate, adjust and after becoming familiar with its construction, if necessary, repair it. It has a maximum speed of ten miles an hour. The engine is designed with a view to simplicity and reliability.

Part of Wreckage Made by Falling Tank, Showing Damage Done to Concrete Floors.

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UNLOADING ORE FROM VESSELS AT THE DOCKS. WITH AN ELECTRIC CRANE.

A simple carburetor with only two simple adjustments that will start the engine with regularity and promptness, a thermo-syphon system of cooling through integral cast cylinder jacket and spiral tube radiator, and an inclined steering wheel directly connected to the front axle, also carrying spark and throttle on steering column, the same as on large motor cars, make this a real motor car for the young folks.

The speed of the car is varied by manipulation of spark and throttle levers and allowing drive belt to slip by reducing pressure of foot on clutch pedal. Ten miles an hour is the maximum speed of this little machine. The car weighs about 300 pounds.

ELECTRICITY DISPLACES HYDRAULIC POWER

UNTIL recently the big clam shell machines with twelve ton buckets for reaching into the hold of an ore vessel have been operated by hydraulic power. The new unloading plant at Lorain, Ohio, is operated entirely by electricity and in addition has a new arrangement for carrying ore that does not go directly into cars to the stock piles or a trough at the rear of the machine, as shown in the photograph. This plant is on the docks of the United States Steel Corporation. Another plant of electric machines is now being installed at Ashtabula, Ohio.

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CONSULTING DEPARTMENT

Are you puzzled by any question in Engineering or the Mechanic Arts? Put the question into writing and mail it to the Consulting Department, TECHNICAL WORLD MAGAZINE. We have made arrangements to have all such questions answered by a staff of consulting engineers and other experts whose services have been specially enlisted for that purpose. If the question asked is of general interest, the answer will be published in the magazine. If of personal interest only, the answer will be sent by mail, provided a stamped and addressed envelope is enclosed with the question. Requests for information as to where desired articles can be purchased will also be cheerfully answered.

Home-Made Cream Separator

Please suggest some way to separate cream from milk without the use of expensive machinery.—*B. N.*

Provide a reservoir or tank of suitable size, in which the milk may be allowed to settle until the cream is formed at the top. Put in an ordinary pump above the reservoir with the suction end on the bottom. Attach to the suction end a rubber hose, the other end of which is held by a float a certain distance below the cream at the top of the reservoir. Set a small barrel so that the discharge from the pump will flow into it. Attach a discharge pipe, supplied with a stop cock to the underside of the barrel. By this means the skimmed milk can be drawn off without disturbing the cream and distributed from the barrel to the milk cans. The accompanying figure will give an idea of one such installation.

Largest Gold Nuggets

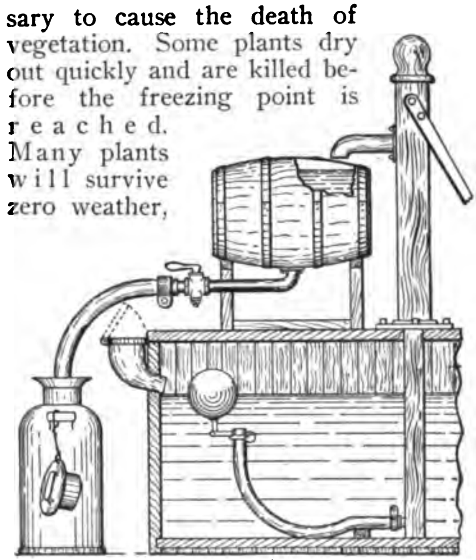
Can you tell me where and when the largest nugget of gold was found?—*N. T. L.*

The largest gold nugget ever found was the Welcome Stranger at Moliagul, in Victoria, in 1869. It weighed 2,520 ounces and was found at a depth of three inches. The Welcome nugget, found at Ballarat, in 1853, weighed 2,195 ounces and was discovered 180 feet below the surface. Recently at Tarnagulla, also in Victoria, four nuggets, weighing 963, 675, 502 and 372 ounces respectively, have been secured in gravel at a depth of only twenty inches.

Not Frost But Thirst Kills Plants

I have been told it is not freezing but something else that kills plants in the fall. If not the cold what is it?—*B. F.*

Plants do not freeze to death in the early winter, but perish from thirst. The cold causes the withdrawal of the water from the cells of the plant, forming ice crystals outside of the cells. The frost cooling and contracting the surface, acts as a sort of pump, and as soon as the cell is emptied of its life-giving fluid the plant dies. The truth of this theory has been proved recently by numerous careful experiments. Great variation was found in the amount of cold necessary to cause the death of vegetation. Some plants dry out quickly and are killed before the freezing point is reached. Many plants will survive zero weather,



A CREAM SEPARATOR THAT MAY BE MADE AT HOME.

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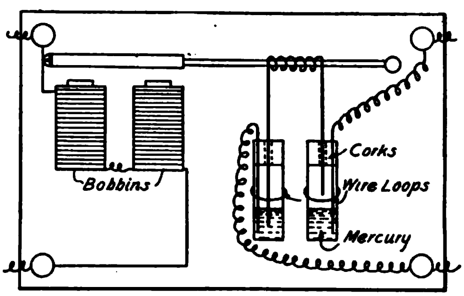
and some die only at twenty degrees below. Certain vegetable growths never freeze. There are forms of bacteria that even when immersed in liquid air, the intensest cold available, come out of their bitter bath as chipper and lively as ever.

Simple Relay for Wireless

Please tell me how to make a relay for a small wireless telegraph.—*S. R.*

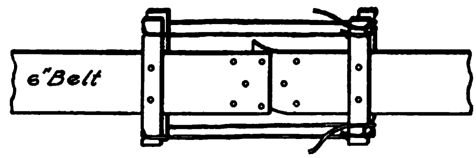
A very efficient wireless telegraph relay can be easily made at the expense of an old electric bell, providing the field magnets and coils are in good condition. Take the coils and cores and fasten them on a board, as shown in the sketch.

Pivot the armature over the magnet poles and wind thick copper wire over



A Simply Constructed Wireless Telegraph Relay.

the end of the bell hammer. The ends of the wire should be straightened out to hang down vertically and one of the ends should be about one-eighth of an inch longer than the other. Below these two ends fasten two glass tubes, each one-half inch in diameter. Put enough mercury in the bottoms of the tubes, so that the end of the longer wire is covered, while the end of the shorter wire does not touch the mercury. Put corks in the top of the tubes with holes in them, so that the wires can move up and down freely. Run another wire into the mercury of each tube from the top, as shown in the figure, to make the connection with the second circuit. When the armature is drawn towards the magnet, the short copper wire is plunged into the mercury, completing the second circuit.



Instrument for Tightening Belts.

Belt Tightener

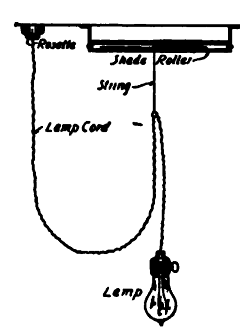
Please tell me how to make a tightener for lacing belts.—*A. M. R.*

The belt tightener shown in the accompanying sketch consists of four pieces of wood from two to three inches wide, one inch thick and long enough to extend several inches on each side of the belt to be spliced. Cut a shallow notch in each piece and place one of the wood pieces behind the belt above and below the splice. Place the other pieces in front of the back ones and drive two wire nails through each and through the belt. Take two pieces of rope about the size of a clothes line, make a loop in each and place the rope over the two cleats at the top, one on each end. Run the rope around the bottom cleats and then back around the top cleats. Pull up on the bottom cleats and tighten the ropes and when tight enough wrap them around the upper cleats with one-half hitch. This will hold the belt tight enough for splicing.

Adjustable Electric Light

Can you suggest a method for raising and lowering an electric drop light?—*S. R.*

A very handy fixture for raising and lowering an electric drop light can be made by fastening a window shade roller to the ceiling and fastening a string to the roller. The other end of the string can be fastened to the lamp cord somewhat as shown in the illustration. The lamp can then be adjusted in the same manner as a window shade is ordinarily adjusted.



Simple Device to Adjust Electric Drop Light.

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Largest Room Without Columns

How large a room can be built without using columns?—*V. W.*

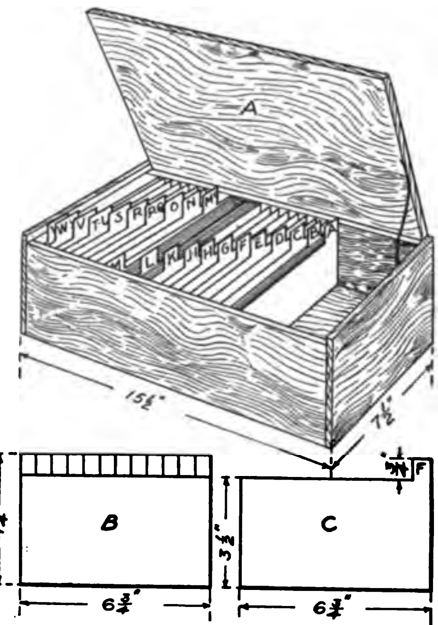
This, of course, depends upon the design and material used, but the imambra connected with the Mohammedan mosque at Lucknow, India, contains the largest room in the world without columns, being 162 feet long, 54 feet wide and 53 feet high. It was built during the great famine in 1784 to supply work for a starving people. It is a solid mass of concrete. In its erection a mould or framework of timber and bricks several feet in thickness was first made, which was then filled with concrete. The concrete was allowed about a year to set and dry, when the mould was removed. Although the building has been standing a century and a quarter, it is said to show no signs of decay or deterioration.

Home-Made Letter File

I would like to know how to make a letter file.—*M. L.*

You will probably find it cheaper and more satisfactory in the end to buy a letter file ready made, but an excellent file for the purpose can be made at home, in which you can keep record of your business transactions, such as bills, receipts, letters, etc.

The materials needed are a supply of quarter inch boards, five-eighth inch brads, two small brass hinges and a quantity of cardboard. Cut two pieces 4½ by 7¼ inches from the ¼ inch boards. These are for the ends of the box; for the sides, two pieces 4¼ by 15 inches, and one piece 7½ by 15 inches for the top. Another 7½ by 15½ inches, for the bottom. In putting the box together, first nail the sides to the ends and then put on the bottom. After fastening the lid on with the hinges, tack a piece of tape on one side to keep the lid from going back too far. For the index cut twenty-four pieces of cardboard, 6¾ by 4¼ inches in size. Draw a line ¾ of an inch from the top and divide this piece into twelve equal parts, as shown at B. On two pieces cut all the way but the first piece, on the next two, cut all the way but the second piece, and so on. The completed card is shown at C. These should be lettered with the alphabet. When completed the inside measurements of the file should be seven inches wide, fifteen inches long and four and one-fourth inches deep. This is large enough for an envelope of ordinary



Home-Made Letter-File.

size. The appearance can be highly improved by sand paper and varnish.

X-Ray Moving Pictures

Why could not the kinetoscope be used with the Roentgen ray process to produce moving X-Ray pictures? Would think it would be of immense value in studying the action of internal organs.—*D. K. W.*

Dr. Kohler, of Weisbaden, produced X-Ray kinetoscope pictures illustrating the breathing of healthy and sick persons. This is the first time the inner action in the breathing movements had been demonstrated in this manner. The part played by the diaphragm and the ribs was indicated clearly, as was the palpitation of the heart. The condition of the stomach in a case of cancer was shown also by the same method. If the salts of bismuth, either the subnitrate or subgallate, are administered to the patient before the pictures are taken they are reflected clearly in the Roentgen pictures.

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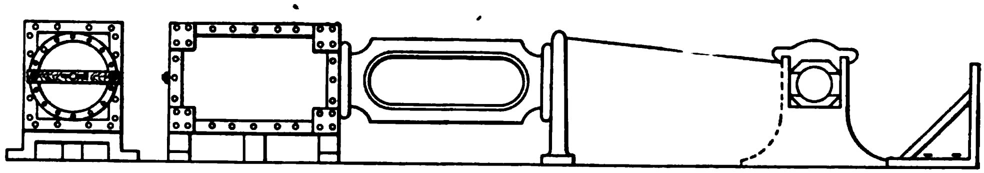

FIG. 1. DIAGRAM ILLUSTRATING METHOD OF LINING UP AN ENGINE.

To Line Up an Engine

Please tell me how to put an engine in line. —*G. D. D.*

In lining up an engine first take down the connecting rod and make a mark on the cross-head. Then shove the piston up till it strikes on the cylinder head and back till it strikes the stuffing box. Make marks on the guide in each position to correspond with the marks on the cross-head. This is to aid in equalizing the clearance. Remove the cylinder cover, disconnect the piston rod from the cross-head and take the piston out of the cylinder. Fasten a stick across the head end of the cylinder by means of two opposite stud bolts, as shown at the left of figure 1. At the crank end and beyond the bearing, erect a support as shown at the right of figure 1, and draw a fine cord through the cylinder and the packing box. With a pair of inside calipers center the line on the cylinder and packing box. Adjust the main bearing, then place a level on the shaft and if it is true, turn the crank until the crank pin touches the cord, as in figure 2. If the cord does not cross the middle of the crank pin, move the out-board bearing until the cord crosses the center of the pin. Turn the crank to the other center and repeat. This will line up the shaft.

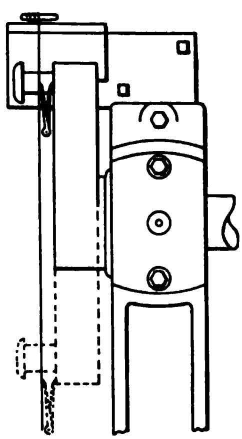

FIG. 2. LINING UP AN ENGINE.

With the crank vertical put a steel square against it as in figure 3, bringing the upper edge to the center of the shaft. If the square touches the cord, the shaft is in the correct position. Make sure that the cord has not been moved in the foregoing operation. Replace the piston in the cylinder, attach the rod to the cross-head and see that the marks on the guide and cross-head match the same as before. If not, turn the piston and rod until the marks are correct. Then tighten up the jam nut, put up the connecting rod and place the crank first on the head end dead point and then on the crank end dead point. Take up the clearance as shown by lines on the guide.

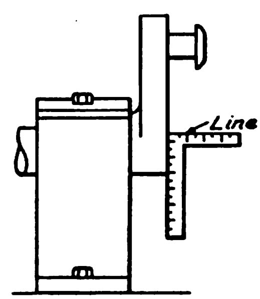

FIG. 3. LINING UP AN ENGINE.

Remedying Scratched Negatives

How can I retouch scratched negatives?—*R. S. M.*

Clean them thoroughly with an old tooth-brush, scrubbing the scratches along their length so as to remove all accumulated dirt. Use plenty of water; it would be advisable first of all thoroughly to wet the gelatine side so as to avoid marking it. After thoroughly cleansing the scratches, dry the negatives in a current of air; the scratches should then be painted over two or three times with a solution of Canada balsam in turpentine or Xylol, painting this solution along the length of the scratches, and allowing each application to dry before applying another. The glass side of the plate should then receive a further coating of the varnish—all over the surface—and you will then have overcome any possibility of the marks printing.

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GENIUS DISCOVERS NEW MOTIVE POWER

By EDWIN WILDMAN

MR. EDWARD C. WARREN, who created something of a sensation in the engineering world a few years ago by the introduction of his pressureless contact rotary engine and his pressure generator, for converting steam engines into internal combustion engines, is again attracting wide attention by his revolutionary announcement of an "oxygenated fuel" to supplant gasoline, alcohol, petroleum and coal in the production of engine power.

Mr. Warren is an authority on the question of fuel and power and his work and researches are of a highly practical, though radically pioneer character. He believes that the art of harnessing Nature's forces for the production of useful power is far behind other lines of scientific achievement and that the near future will witness a tremendous change for the better in this important field.

In this belief, Mr. Warren is not alone, however, for Sir Hiram Maxim and Nikola Tesla are both working in this field and have each recently suggested that a radical change in the world's motive power is impending.

When asked recently what he thought of Mr. Warren's new "oxygenated fuel" Mr. Tesla said: "Warren is a genius and an engineer of known ability and anything that he states will stand on its own bottom."

Questioned about his new oxygenated fuel for internal combustion motors, Mr. Warren said: "The rapid development of flying machines of the aeroplane and dirigible balloon types has keenly accentuated the insistent demand for an absolutely dependable and economical heat motor. To the mind of the student of power engineering the conditions disclosed by an analysis of the gasoline motor now so universally employed must present a serious indictment of the efficiency of the producing section of the engineering fraternity. When we contemplate a reciprocating piston explosion motor, designed to meet the power requirements of such advanced scientific developments as the navigation of the air, where it is of supreme importance to secure the maximum reliability and certainty of action, in combination with the greatest pos-

CAPTAIN EDWARD WARREN.
Discoverer of "oxygenated fuel."

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sible economy of weight of motor and fuel, and realize that during only one-fourth of its working time is the motor actually delivering power, or, in other words, that in most cases, the motor operates at less than one-fourth of its actual mechanical capacity for power, we can hardly regard this type of motor as a creditable scientific achievement.

"The primary defect in the internal combustion motor as it now exists, is, of course, its uncertainty of action. An explosion motor depending upon the combustion at a given instant of a charge of accurately proportioned vaporized fuel and atmospheric air, can never be made a dependable machine. If we are to sail aloft in a heavier-than-air flying machine sustained wholly by its motive power we decidedly want a motor that will keep going, for, with this type of machine, stoppage of the motor means immediate and unavoidable descent to earth—or water—as the case may be, and it is therefore obviously of the first importance that accidental stoppage of the motor be reduced to but the most remote possibility.

"How is this to be accomplished? By producing an internal combustion rotary motor. Much has been written by eminent engineers, American and foreign, upon this subject. A turbine or other rotary type of motor might be expected to be far less subject to derangement and accidental stoppage than a reciprocating form of motor, but it seems that insuperable difficulties have been encountered in the efforts to operate a turbine on the internal combustion principle, with the gases of combustion acting directly upon the turbine blades.

"In using gasoline or other liquid fuel for power on the internal combustion principle, the fuel, after being introduced into the combustion chamber or engine cylinder, must be supplied with the oxygen requisite for its combustion. This is commonly done by compressing atmospheric air in the working cylinder of a reciprocating motor; in some cases the vaporized oil being previously mixed with the required volume of air and in other cases, as in the Diesel motor, the oil being injected into the highly compressed volume of air at the instant when combustion is desired, the heat of compression serving to ignite the jet of fuel. The effect of either method is to convert the motor, for one stroke in each cycle, into an air-compressor, driven by the stored energy of the fly-wheel, so that the 'motor' is, in fact, a combination of manufacturing machine and prime mover.

"Now the sole reason that our existing motors are unable to operate at their full mechanical capacity as prime movers and so develop double or quadruple their present power, is that the hydro-carbon fuels upon which they operate require for their combustion the addition of a large proportion of another element, oxygen, without which the 'fuel' is incapable of yielding any power.

"If the fuel itself were a completely combustible substance and could be ignited in the cylinder or combustion chamber of the motor without the admixture of any other substance, there would be no loss of mechanical efficiency, and the entire working time and mechanical capacity of the machine would be devoted to the delivery of power. We could then obtain from two to four times the horse-power from a motor of given weight as is now possible, the operation of the motor would be materially simplified and its reliability vastly improved.

"And it is to realize this desirable condition that this proposition to employ an 'oxygenated fuel' has been developed. I have manufactured the fuel and burned it and have demonstrated that the dollar-cost of mechanical power may be cut in half, while the power capacity of a given weight of motive equipment is multiplied by four. It is simply a question of relegating to the manufacturing plant the entire work of manufacturing the motive fuel, in order that every pound of motor may be employed continuously in the delivering of power. We are thus enabled to work both the manufacturing and the power producing equipment up to the point of maximum production and maximum efficiency.

"What is the fuel made of? Well, I can't go into details just yet, but I will say that the fuel is simply a mechanical mixture of a carbonaceous substance, such as coal, lignite or peat, with a natural oxide or oxygen-bearing substance."

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CAR OF MANY USES

By DR. ALFRED GRADENWITZ

BERLIN CORRESPONDENT TECHNICAL WORLD MAGAZINE.

ARMY authorities in Germany are considering the adoption of a transportable bivouac invented by a Russian engineer, Mr. Ostrowsky, at present living in Berlin.

This bivouac is likely to render invaluable services in warfare and during manoeuvres, affording to the men the benefits of camp life.

The bivouac takes the form of an ordinary car of modest dimensions and in itself constitutes a small flying barrack, comprising, outside of the men's compartments, an officer's cabin, a field kitchen and even an observatory tower, which may also be used as a wireless telegraph station. The frame and the roof of the compartments are made of steel tubes, insuring an extremely low weight and remarkable stability. The men's quarters are provided with a roof of aluminum sheets.

After the car, which is readily hauled by a team of two horses, has arrived at its destination, two levers terminating in anchors are taken off the driver's seat and dropped on the ground; these levers, which during the transport of the car were passing through its rear axles, while keeping back the fore axles by means of hooks, now maintain the rear wheels in position while the front wheels, being released of the levers, are carried along by the horses until the car is drawn out to a distance of about eighty feet.

THE CAR EXTENDED.

Each of the compartments of the flying barrack constitutes a room of its own, with three windows.

Those compartments are arranged in two stories; a large staircase connects the entrance with the upper floor while a big sliding door gives access to the lower compartments.

BIVOUAC CAR FOLDED UP.

The whole structure constitutes a lengthy building, including in its two stories twelve compartments for the soldiers, an officer's cabin and a sergeant's office with a cabinet for documents. At the end of the car is the field kitchen, with a larder. Each of the compartments is provided with any necessary pieces of furniture, such as beds, tables, etc., arranged so ingeniously that each of them, during the closing of the car, is folded up automatically. The officer's cabin is even appointed with a certain luxury, comprising electric light, a writing desk, looking glass, comfortable washstand, etc.

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BIVOUAC CAR EXTENDED, WITH WALL AND ROOF REMOVED AND TOWER ERECTED.

At the rear end of the car is arranged an observatory tower, susceptible of being lowered and raised to a height of about one hundred feet by the aid of lazy tongs and a screw spindle. This also lends itself for use as a wireless telegraph station. A well protected platform which communicates with the car by means of an elevator is actuated by the muscular energy of the men themselves.

The same type of car can be used as a flying hospital, and in this connection may prove itself even more useful. It may in fact be taken for granted that

THE INTERIOR OF EXTENDED CAR.

many lives are lost simply because the wounded are unable to stand the transport to the too frequently distant hospital. These cars which, when used for camping purposes, accommodate a whole company, will render invaluable services in the case of catastrophes by which many persons are wounded. The Red Cross is considering the adoption of these transportable hospitals, the price of which—$1,200 to $1,500—may be said to be very moderate.

When the car is used as a flying hospital, the observatory is replaced by a room for surgical operations.

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MAY

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DREAM-COME-TRUE

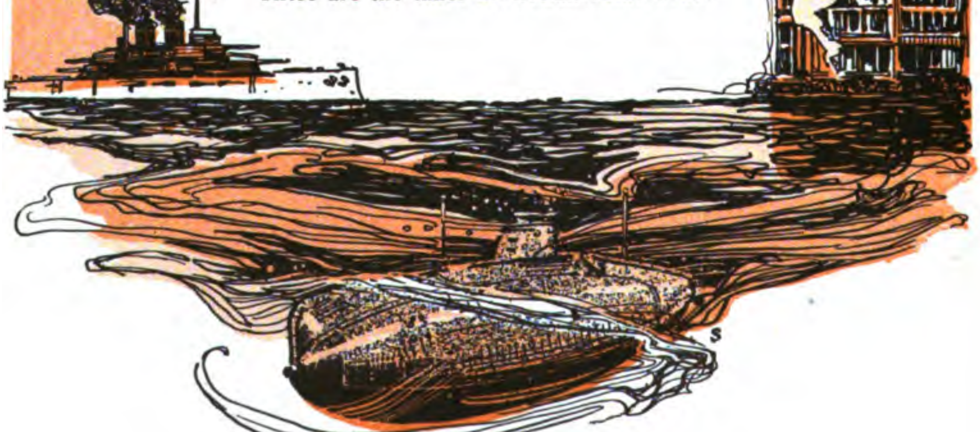
By Charlton Lawrence Edholm

Heir of our age, from Golden Age banished,
  Where are your song-built cities of foam,
Ninevah, Babylon, Troy-town?—Vanished.
  Say, where is Samarcand's bubble dome?
  Nay, lift your eyes from the Rhymer's tome:
Look o'er the City: did Xanadu
  Outshine the heavens like this, our home?
These are the times of Dream-Come-True.

Poet, come with me through swirling streets.
  Dreamed you such pageantries? On what page
Found you the glory of light that beats
  Full on the Poem of Our Own Age?
  Cloud-piercing towers here flank a stage,
Calling for deeds such as Titans do;
  Wonders! Your thirst for wonder assuage:
These are the times of Dream-Come-True.

Marvels, by dreamer in vision seen,
  Every man sees them as common things:
Frighting the nereids, the Submarine
  Prowls where a helpless keel o'erhead swings:
  Flung in the Blue, lo, your whisperings
Half 'round the earth are snatched from the
      Blue:
  This is the age when Man soars with wings!
These are the times of Dream-Come-True.

  Envy no more any Golden Age
    Prince of the Domains o' Dream, for you
  Enter now into your heritage:
    These are the times of Dream-Come-True!



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THE TECHNICAL WORLD MAGAZINE

Volume XI MAY, 1909 No. 3

NEW LINK BETWEEN INDUSTRY AND EDUCATION

By RAYMOND F. RICE

THE faculty of the University of Kansas has recently sent out to the other great universities of the United States and Europe an announcement which, if read between the lines by ambitious young men, will be found to offer one of the greatest opportunities open to brains, invention and scientific industry. A scholarship has been established and is looking for the right man, for the purpose of making original research to find a way to obtain from glass its maximum illuminating power. The scholarship carries with it an income of $1,500 per year for two years, and offers ten per cent of the net profits to be derived from the discoveries its holder shall make. A most remarkable departure from any method heretofore adopted has brought the university and the business man—the manufacturer—into close touch in a surprising fashion and results are being obtained that are more than surprising.

The average manufacturer of the last generation was firm in the belief that everything of any value in connection with his business might be learned within the walls of his factory, and that for one who wished to master its details, a scientific or technical education was useless. In time, the value of training along mechanical lines was recognized, and at last the industrial world is beginning to see that there is a close and vital connection between chemistry and industrial efficiency. Some of our largest and most successful manufacturing establishments have fitted out laboratories for testing and research work, and are filling them with trained chemists from the university class rooms and laboratories.

It is possible, however, for the universities to be brought into still more intimate relations with the industrial life of the country, and to perform another function even more valuable than the supplying of trained chemists to the manufacturers. This work they are already doing in Germany, where the universities are no longer content with theories alone, but have invaded the realm of the practical and become joint workers with the manufacturers. They have made the problems of the industries their problems, and the present industrial rank of Germany is due in no small

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THE INVESTIGATORS IN THE CHEMICAL INDUSTRIAL FIELD WHO ARE CARRYING ON THEIR EXPERIMENTS AT THE UNIVERSITY OF KANSAS.
Top row, from left to right: F. W. Bushong, H. A. Kohman, E. L. Tague, F. W. Faragher. Bottom row: A. J. Weith, F. P. Brock, Prof. R. K. Duncan, R. C. Shuey.

degree to the discoveries which have been made in the university laboratories, and put to practical use in the mills and factories.

These facts were in the mind of Robert K. Duncan, when some three years ago he was called to the professorship of industrial chemistry in the University of Kansas. In the hope that he might interest the manufacturers in his department, and do a work that would be of vital importance and assured value to them, he inaugurated a plan by which, as he expresses it, "in a spirit of sympathetic co-operation, the university and the manufacturer might each profit, and the people through both—a scheme of Temporary Industrial Fellowships." The purpose of this plan is to enable the manufacturer who feels the need of assistance along chemical lines either in the direction of utilizing waste, increas-

WHERE SCIENCE AND BUSINESS MEET.
Chemical Laboratory Building, University of Kansas.

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ing the efficiency of his factory or discovering new uses for his products, to secure for a very moderate sum the services of a trained chemist, who will devote two years of his time to the solution of the problem set before him.

Let us take a specific instance, and see how the plan is working out in practice. The proprietor of a creamery who has been following the common practice of pouring his buttermilk into the sewers for years finally comes to the conclusion that it may contain some constituents worth preserving, if they can be cheaply separated from each other, and states his problem to the University. He receives the reply that for the sum of $500 a year he can found an Industrial Scholarship, the holder of which will devote practically his entire time to the task of separating and utilizing the constituent elements of waste buttermilk. The offer is accepted, and a young chemist appointed by the Chancellor of the University, the Director of the Chemical Department and the Professor of Industrial Chemistry, begins his work. His entire time is devoted to his research work, with the exception of three hours a week, which he gives to the work of instruction in the chemical department, in return for the use of the university laboratories and for his supplies.

The young investigator commences his work under the most favorable auspices. His income, to be sure, is not large, but it at least affords him a living, and it is to the future that he looks for his great rewards. The laboratories of a great university are his work rooms; thousands of technical books are at hand for reference, and he is in constant touch with the head of the department, who has himself discovered several valuable processes, as well as having made notable contributions to the literature of industrial chemistry. Again, with two years at his command, there is ample time for the work and every incentive to thorough and exhaustive research. Nor is the

TO SECURE BETTER BREAD IS A SERIOUS SCIENTIFIC PROBLEM.

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holder of the fellowship working blindly or without hope of success; on the contrary, his problem is definite, and it is one of whose probable solution the founder is so confident that he is willing to stake at least a thousand dollars on the result.

While the end is definite, it must not be supposed that the work is easy or simple. It is known that the principal and most valuable constituent of buttermilk is casein, and that it also contains lactic acid and sugar of milk, but the discovery of a simple and economical method of separating these elements is in itself no easy task. The complexity of the work, as well as its value, becomes still more evident when we consider the variety of uses to which the casein alone is adapted. Casein is an albuminous substance, with which we are more familiar as the curd or coagulable part of the milk from which cheese is made, and it may not only be used as a food and as a medicine, but also in the manufacture of waterproof and fireproof paint, oils, imitation leather, and photographic plates, and in the printing of wall paper.

In view of the favorable conditions under which the holder of the fellowship is working, and the progress which has already been made, the prospects for the successful solution of his problem are very bright, and we shall assume that at the end of the two years' period he will have discovered a cheap and practical method of extracting from buttermilk its principal constituents, and have learned

FINDING OUT HOW TO IMPROVE THE ENAMEL USED IN LINED STEEL TANKS.

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A WELL-EQUIPPED LABORATORY IN THE DEPARTMENT OF INDUSTRIAL CHEMISTRY.

the most valuable uses to which they may be put. Perhaps he will also have invented some mechanical device to aid in the process of separating the elements. But whatever his discoveries or inventions, they become the property of the founder of the fellowship, to whom the holder must also assign all patents taken out by him. He does not, however, like so many pioneer inventors, sow only for others to reap all the honors and rewards, for it is understood that the discovery or process is to be regarded as his; and in addition to this that he is to receive a percentage of the profits derived from his discoveries. This percentage is usually ten per cent of either the net or gross profits, but in some few cases the amount has been left open for future determination.

The University will not, however, permit the discoveries and inventions made in its laboratories to become a perpetual monopoly, even in the hands of those who have made them possible. On the other hand, it insists that they shall become public property after a reasonable time has been allowed for their exclusive use by the founder of the scholarship. In no case can this period of monopoly exceed the seventeen years within which inventors are permitted by the United States patent laws to enjoy the exclusive right to make, use and sell their inventions. In addition to this, it is agreed that before the expiration of the fellowship, its holder shall write a thesis, embodying not only his own discoveries, but also that which the investigators who have preceded him in the same field have been able to learn. One copy of this thesis becomes the property of the founder of the scholarship, and a second copy is deposited among the records of the University, where it is to remain for three years, at the end of which period the University is at liberty to publish it, thus carrying out the primary purpose of the fellowships, which is that of promoting the increase of useful knowledge.

There have already been established in

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the University of Kansas six working fellowships, and as the last one of these makes provision for two fellows, seven young men are now at work in the laboratories. A seventh scholarship has recently been founded, but no appointment has yet been made, and agreements have just been concluded for two others, each of which will yield $2,000 a year. It may be of some interest to note briefly the nature of the research work which is now being carried on, in addition to the investigation into the constituents of waste buttermilk.

The first fellowship was established about a year and a half ago, and has for its purpose the discovery of better methods in the laundry industry, especially in connection with the chemistry of laundering. The Chicago manufacturer of launderers' materials by whom this scholarship was founded believes that the business is being carried on in utter disregard of the principles of chemistry, and is confident that a scientific study of the process will enable the laundries to do their work more economically, as well as with less injury to the garments of their long suffering patrons. To assist the holder of this fellowship in his researches, a power washer has been installed in the laboratory. The results thus far achieved have been most encouraging, and give every promise of ultimate success, and that too along lines which will simply revolutionize the laundry business.

Another fellowship which shows how some of these problems touch the every day life of the people, is the one founded for the purpose of investigating the chemistry of baking, and of producing, if possible, better bread at less expense. This scholarship was established by the National Association of Master Bakers with the double object of making a study of this subject, and of qualifying an expert upon whom the Association could depend for advice and service after the completion of his research work. For the carrying on of this work, an electrical oven has been set up, and the odor of

SEARCHING FOR A LESS EXPENSIVE SOURCE OF DIASTASE.
The object is to manufacture a new fodder on scientific principles.

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INVESTIGATING THE CONSTITUENTS OF PETROLEUM.
A special examination of the merits of Kansas oil.

fresh bread occasionally mingles with the fumes of the laboratory.

An examination is also being made of the constituents of petroleum, with special reference to the properties and uses of Kansas oils; and another investigator is engaged in a search for a new and less expensive source of diastase, a substance having the property of converting starch into sugar. The present purpose of this latter scholarship is the manufacture of a new fodder on scientific principles.

The two fellows last appointed are engaged in an attempt to improve the enamel used upon the enamel lined steel tanks which are indispensable to the carrying on of chemical operations on a large scale. This work was undertaken on behalf of the most extensive manufacturers of these tanks in the world, and the scholarship founded by them yields $1,300 a year, with a further sum not yet determined upon, to be paid for the services rendered.

As noted above, the agreement for a seventh fellowship has recently been concluded. The founder is a glass manufacturing company which is vitally interested in obtaining from glass its maximum illuminating power. The company has already made an exhaustive investigation into the laws of physics in their bearing upon the illuminating properties of glass, and now desires to determine the relation which exists between the optical properties of glass and its chemical constitution. The investigator will work upon this problem.

A new line of investigation will be opened up by the fellowships just founded by two large manufacturing companies, one engaged in the manufacture of cement and the other of ozone. Both believe that instead of having exhausted the possible uses of their products, they have barely scratched the surface, and that where one use is now known, there are dozens of others awaiting discovery. For the purpose of having a systematic examination made into the properties and uses of their products, and thus extending their markets, they

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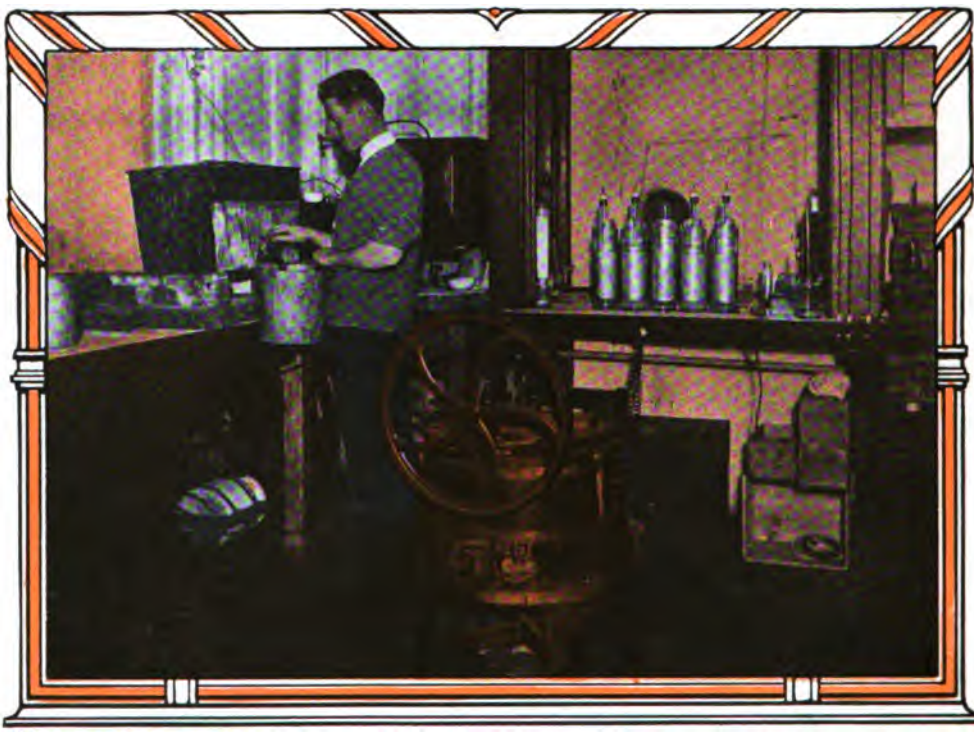
want the very best men obtainable, and are willing to pay liberally for their services.

It is a noteworthy fact that most of the fellowships have been founded by large manufacturers, whom we might expect to find carrying on these experiments in their own laboratories. They have learned, however, that they have neither the library nor laboratory facilities for such research work, and that is enabled to obtain expert advice and services for a moderate sum. If a single manufacturer feels himself unable to bear the expense of founding a scholarship, it will be easy for several to co-operate for the purpose, and enjoy the results in common.

The few fellowships which have been founded barely suggest the possibilities for useful service which are opening up in this new field of activity. Today,



LEARNING TO CARRY ON THE LAUNDRY BUSINESS IN ACCORDANCE WITH THE LAWS OF CHEMISTRY.

their problems demand assistance from the outside. Not only can the universities do this work better than the large manufacturer, but they are also in a position to render to the small manufacturer a service of which he is sadly in need, but which he cannot otherwise obtain. The waste and inefficiency of the average small factory is appalling, and increased efficiency must be brought about largely through such agencies as the industrial fellowships, whereby the small producer there are only a half dozen scholarships, all in a single institution, whereas the industries of the country are in desperate need of at least as many hundred. It is true that the manufacturers are only dimly conscious of their need, and most of them do not know whither to turn for assistance, but when they awake to the value of this research work in the universities, no single institution can hope to provide facilities for work of this character.

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FUTURE MONARCHS OF THE HERD.
Thoroughbred calves of the finest stock, with attendant.

SETTING A PACE FOR THE FARMERS

By THOMAS D. RICHTER

A "MODEL FARM," built at the cost of several millions of dollars and maintained exclusively for the betterment of the Dairy and Farm conditions in this country, is the pleasing, yet unusual, work that is engrossing the attention of Nelson Z. Graves, a Philadelphian, who has amassed a great fortune in the paint and varnish business. This remarkable undertaking has required the use of an immense farm of 1,300 acres at the famous seashore resort at Cape May at the southern point of New Jersey.

Mr. Graves' undertaking, which has now reached a point of development that makes it no longer an experiment but a decided success, is designed to show what can be accomplished with the dairy and farm by the employment of the finest kind of stock, the use of the most sanitary and up-to-date appliances, the proper care, and, above all, rigorous attention and absolute cleanliness.

If President Roosevelt, himself, or the commission of noted men which he recently appointed to investigate and suggest means of improving the conditions in farming and dairy work could pay a visit to Cape May they would have no need of further travel. They would find what the hundreds of visitors from all parts of the country to this model farm

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GENERAL VIEW OF NELSON
It covers 1,300 acres and has none

weekly pronounce "Farming Ideal." They would see stretched out before their eyes acre upon acre, running into the hundreds, as far as vision reached, soft green pasture, waving corn fields, groups of massive, handsomely appointed buildings, scores of live stock and thousands of chickens, the note of cleanliness predominating—a Model Farm.

So all these broad acres, this great work of improvement that is now going on, and which bears the fitting name of the "Farmstead by the Sea," has for its aim and object the practical application of one principle—the uplifting of farm conditions, the development of dairy and poultry productions and the improvement of the breed of stock.

It is doubtful if there is anywhere in the United States a farm of such great proportions devoted to such a work—a farm and dairy whose sole end and aim is not financial gain, but rather gain for mankind. When the Farmstead was first opened, and in fact, daily since that time, farmers came to the Farmstead, attracted by the glittering reports they had received. None was too humble to receive a welcome. Certain of the attendants were detailed as guides and the visiting farmers were shown over the entire plant. Naturally little explanation was necessary, for the basic principle was thoroughly understood by them all. However every new appliance and every new method that tended to elevate the business and made for cleanliness and sanitary development were thoroughly gone over.

The result was that when these farmers returned to their own farms, filled with the wonders they had seen, they immediately began, to the best of their ability, to imitate and even to originate. That South Jersey owes a debt of gratitude to Mr. Graves' "Model Farm" can be seen by a tour of the farming district in that wonderfully productive section of country. His ideas, and the arrangements set forth in his farm are copied everywhere.

Aside from the money spent in the ground the Farmstead cost Mr. Graves $120,000. He says that every cent spent on exceptional improvements, such as the telephone system and electric lighting, and hot and cold water systems, is being repaid by the increased yield, the freedom from filth, sickness of stock or chickens, and higher quality of goods.

Philadelphia, as well as Cape May, where he spends his summers and carries

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Z. GRAVES' MODEL FARM.
but thoroughbred stock and poultry.

out his work, have been the beneficiaries time and again through reason of Graves' willingness to foster anything tending to help the farmers and those living outside of the big cities.

The Farmstead by the Sea is the evolution of this idea, and in this grand consummation his perseverance and open-heartedness have had their reward.

But this fine Farmstead was not perfected without the expenditure of a large fortune and several years of labor. About three years ago Mr. Graves bought an immense tract of grounds of hundreds of acres and to this he added until his domain now comprises fully 1,300 acres. Then he began working on the plans while at the same time he cast his eye about for a man capable of managing such an estate. His choice fell on J. P. MacKissic, who had spent fifteen years in the farm and dairy business in and about Cape May, who knew the country, the weather and soil conditions, was a good manager, and above all thoroughly understood stock and poultry.

This much settled Mr. Graves took his manager into his confidence and had him assist in the planning of the buildings and the various divisions of the farm. He spared no expense, his one idea being to establish the model farmstead of the United States.

Only last October the plans were perfected and the place was opened, but in the short time that has elapsed the success of the Farmstead has been demonstrated. The dairy and farm are running to their full capacity and the hotels and cottages throughout Cape May and the nearby points are clamoring for the products. Mr. Graves has certainly proved that the model farm has come to stay and that it is only a matter of time when the products of none other will be accepted on the market.

To persons who have never visited Cape May and whose only knowledge of a seashore resort is a cluster of hotels, a board walk, bathing beach, stretches of hot sand, and mosquitoes, the thought of a farm and dairy of large proportions seems out of place. In few places could such a thing be possible. But in Cape May it is different. One only has to go a few blocks from the beach to encounter a fresh water lake, green and shady spots with blooming plants and fields of corn and vegetables.

So when the visitor, Farmstead-bound, leaves the Cape May hotel section he soon strikes the main seashore driveway

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that cuts a clear course through New Jersey to Camden. About a mile out of the town the country assumes a changed appearance. Instead of ill-kept fields, and haphazard arrangement of fence rails, a new type is encountered. This is a fine, substantial three-bar, planed-wood, fence, with an upper bar painted a deep green. All the rest of the fence is a clean white.

This skirts both sides of the roadway for almost a half mile, while in the distance on both sides can be seen miles of the same kind of fences, stretching in all directions, intersecting and cutting the ground into a variety of corn fields and pasture lands. The green and white fence is a symbol of the Graves' Farmstead. Turning from the main roadway is another quarter mile driveway that brings the visitor to the office building which stands surrounded by a half score of buildings, large and small. Just where the lane cuts off from the Camden road, however, is a building that appears to have no connection with a farm. It is more in the nature of a fine, large residence. It is an innovation in the history of the farm and marks a departure that will be appreciated and repeated. The building is the Farmstead Clubhouse, where Cape May folk and visitors are privileged to visit and enjoy all the conveniences and delights of the regular country club.

NELSON Z. GRAVES, OWNER OF "FARMSTEAD," THE MODEL AGRICULTURAL ESTATE.

The equipment of this clubhouse is of the finest. No private home or big organization could be better fitted out. There are rooms for every conceivable use, while the entire front of the building is skirted by a wide porch, fronted by handsome shade trees and a level lawn intersected with cement walks.

Close by is the home of the manager, a cottage of large proportions and splendid equipment. The building is well planned and constructed and compares favorably with the best seashore cottages.

The lane swings around behind the clubhouse and divides. On the left is the one-story office building with the long rows of chicken houses on the left side. On the right side is the dairy and the large main barn, the Holstein barn and the calf or yearling barn. Still further to the right are the stables for the horses and the house for the farm laborers and attendants.

Fifteen helpers do the work on this big farmstead under the direction of Manager MacKissic. What such a large force means can be judged when it is considered that there are only about 145 head of stock and three thousand chickens, so that the proportion of work is one man for every ten head of stock and two hundred chickens. It can be seen that there is no lack of care and attention for every living object on the farm. Of the cattle seventy-five are Jerseys and twenty-five Holstein Friesians, all thoroughbreds and of the finest stock. In fact there is not a bit of stock or a bird on the grounds not of the finest registered thoroughbred stock. Mr. Graves intends to improve the breed of the thoroughbred and will permit of no weakening of the strain.

The three thousand chickens are of two kinds—the white leghorns and the wyandottes, all of pure-bred strains. Each of the two types of cattle occupies

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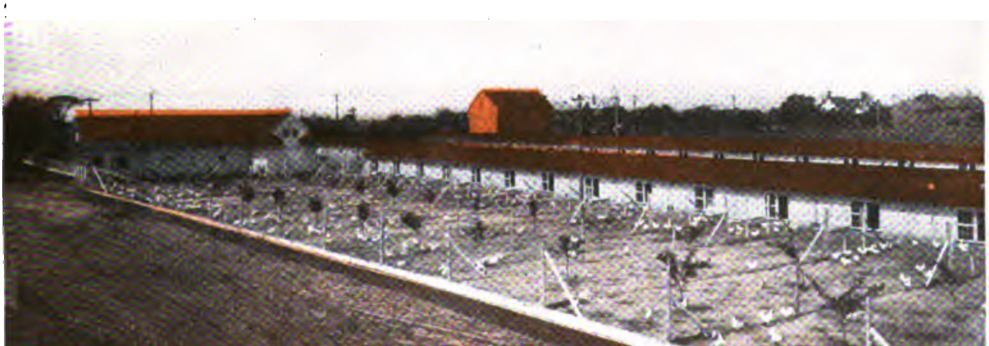
FARM BUILDINGS AND FENCES THAT DELIGHT THE EYE.

different barns. The Jerseys being in a majority occupy the large or main barn. The interior of this is a welcome relief after visiting the usual ill-smelling barn encountered on most farms. Everything is sanitary, all else being sacrificed to this principle. The most stringent laws of the Sanitary Commission have been complied with as they are in few other places, and they have even been improved upon, so that visitors who possess technical knowledge of such matters have marveled at the wonderfully developed system of sanitation.

The ceiling of this barn is lofty, with glass skylights at intervals on the sides



ROOMY CHICKEN HOUSES. ELECTRIC LIGHTED AND HEATED. AND COOLED WITH WATER SYSTEMS.

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ANOTHER PANORAMIC VIEW OF

to permit the free access of light and air, both so often absent on the ordinary farm and both so necessary to the breeding of the best stock and the giving of fresh and healthy products.

The floors are of cement. The greatest surprise to the ordinary visitor, however, is the entire absence of stalls. Instead, where the walls of the stalls would be only a single-bar, iron railing separates the cattle. These are arranged in parallel lines with the heads of the cattle facing. In between are the feed troughs which are constantly being cleaned and refilled with the finest kind of fodder.

The occupants of these compartments are not chained, neither are they tied. They are confined, however, with an arrangement that resembles a yoke. It is of metal and is attached to a chain swinging from above. It is padded on the inside like a regular horse collar to prevent chafing. This does not fit tightly but leaves ample room for free movement on the part of the cow. However, it confines the animal to its space because it is unable to draw its big head through the opening. It is quite an interesting sight to see the long lines of Jersey cattle, their sleek light brown hides glowing, moving freely about in their roomy compartments.

The Holstein herd is over near the railroad tracks, which at this point run between the fences of the Graves estate for almost a mile. These big and impressive looking black and white animals being fewer in number have a smaller barn. But the general arrangement is the same. One feature of the regulations which has been complied with and which tends to aid the development of the breed is the providing of at least 800 cubic feet of breathing space for each cow. Mr. Graves has been over-liberal in this respect.

The calf, or yearling, barn always has a well-filled appearance. The breeding of this fine stock is progressing favorably and the stalls in this building, for here such compartments are necessary, now contain nearly a score of healthy calves.

Attendants are constantly moving about in these buildings cleaning, feeding, and replenishing the supply of bedding. In this respect Mr. Graves has taken a big step forward. Instead of straw or similar material his stock rests on the finest possible bedding, special white pine shavings. Piled up in the rafters of the big barn are tons of the best shavings. The great advantage this material possesses is that it is absolutely sanitary and quickly absorbs moisture without remaining damp.

After the day's work is over a night watchman takes possession of the Jersey barn, where he spends the night cleaning and looking after the wants of the stock, guarding it conscientiously.

In addition to the bountiful pasturage

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HOMESTEAD BY THE SEA.

provided, in the separate divisions of the farm behind each house are a number of runways about fifteen yards in width and about forty-five yards in length. These are used for exercise.

When milking time arrives a force of six men is employed. Each man is attired in a white duck suit with white apron. These experts go about their work with speed and precision and soon complete their task. After each milking the clothes are thoroughly sterilized before being again brought into use. Every cow, being a thoroughbred, is registered. As soon as a calf is a few days old a metal clip is inserted in the ear, where it remains throughout its life. It is a sign of its registration with either the American Jersey Cattle Club, or a similar organization for Holsteins, and indicates its thoroughbred character. It contains its registration number. This is placed on the books in the office and a strict record kept of the daily milkings. Each milking is weighed and the record also kept, so that each cow's record can be maintained. The present capacity of the cows is about 700 quarts daily, while the chickens for their part contribute about seventy dozen eggs in the same length of time.

The dairy house into which the milk is immediately brought is a model of cleanliness. Its white tiled walls and smooth cement floors fairly glisten with their clean polish. This building was built by a man who ranks highest in the world in this class of work, and contains every piece of modern and up-to-date machinery that is necessary. The cooler which takes the milk, still warm, from the cow is a series of pipes that coil over one another. Inside of these pipes passes a steady stream of ice-cold water. On the outside surface of these pipes the milk is passed, the extreme temperature taking out the last particle of animal heat from the pure white liquid.

The milk then passes into the bottle-filler. These bottles have been already thoroughly cleaned and sterilized by machinery. The bottle-filler is capable of disposing of 100 quarts of milk in five minutes! With this great capacity virtually no time is lost in getting the product under cover and avoiding the possibility of infection. The same principle is applied to the cream separator. The bottles are then placed in the refrigerator, which is a handsomely tiled affair. At the proper time the Farmstead's neat looking little milk wagons begin their work of distribution.

The poultry end of the business in itself presents a little city. The houses arranged in long rows cover a great amount of ground, for it is not permitted to crowd this fine lot of chickens. Every little house has a large runway walled in with wire netting. The grounds are clean and contain small trees. The food is carefully prepared, so that there has

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not been the slightest trouble through sickness.

The maintaining of an even temperature and the keeping of the various buildings, even down to the chicken houses, in perfect condition as regards cleanliness—usually a matter of difficulty—is solved very ingeniously on the Farmstead by the employment of a system of hot and cold water pipes. Every part of the grounds is underlaid with these pipes and every building is warm in winter and cool in summer.

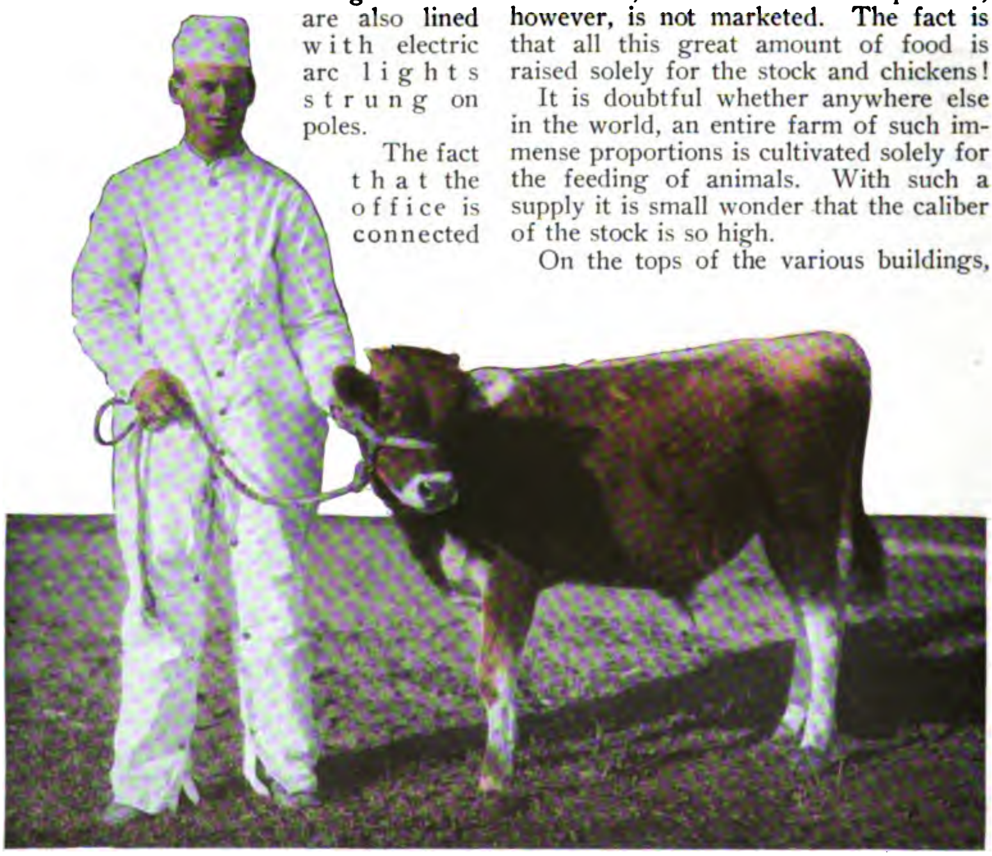
This is strictly an up-to-date farm as regards the installation in the various buildings of electric lights, telephones, and all other forms of adaptable electricity and engines. Within, each barn can be made as light as day during the night, thus obviating the necessity of employing the always dangerous lantern or other light. The roadways throughout the grounds are also lined with electric arc lights strung on poles.

The fact that the office is connected with local and long distance telephone permits Mr. Graves to have put into working order a plan that he cherishes. Now it is possible by this means for Cape May cottagers, when leaving Philadelphia or even New York or any other point, to call Cape May on the long distance 'phone, get into communication with the Farmstead office and leave their order for any kind of dairy produce. As soon as the party arrives at Cape May the order is at hand. This also is an innovation with the "Model Farm."

To the casual observer the great fields of corn and other grain would indicate that strict farming was the intention of the originator of the Farmstead. Such, however, is not the case. As far as the eye can see in the direction of Schellenger's Landing and in the direction of the Hotel Cape May, which, by the way, receives its dairy supplies from the Farmstead, are corn fields. The product, however, is not marketed. The fact is that all this great amount of food is raised solely for the stock and chickens!

It is doubtful whether anywhere else in the world, an entire farm of such immense proportions is cultivated solely for the feeding of animals. With such a supply it is small wonder that the caliber of the stock is so high.

On the tops of the various buildings,



A HUSKY HANDFUL.
Young bull, the pride of the herd, with attendant in farm costume.

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MODEL BARN WITH SILO FOR WINTER FEEDING.

siloes, four in number, have been built. These are so high that they can be seen for miles in all directions. These are receptacles for the foodstuffs that are to supply the stock and chickens throughout the winter. In them the material is kept as green food for the winter weather, so that instead of being forced to exist on dried or specially prepared food the animals have it as fresh as

INTERIOR OF BARN USED FOR JERSEY COWS.

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·HERD OF THOROUGHBRED JERSEY CATTLE—SOME OF THE FINEST STOCK IN THE LAND.

when brought from the fields. The stalks are the best food for the cattle, the corn from the ears being used in the preparation for the chickens.

The best well water supplies the Farmstead and rounds out what is beyond doubt the most completely equipped, ideally located, and sumptuous affair of its kinds in the world.

This great Farmstead, even despite the great outlay of money, which was probably somewhat more than the ordinary farmer, even in proportion to his wealth, need have put into it, delivers a fine profit of fifteen per cent. This surprising showing is all the more remarkable in view of the fact that the farm is a little over a year in operation and has not yet been pushed to its full capacity.

Not only has the material or financial profit been large, but there has been a wonderful increase in the size of the herd and the number of chickens. In this latter respect it might be noted that there are fully five hundred more chickens than when the farm started, despite the fact that the eggs have been sold in such large quantities. Then, too, sixty new calves have been born during this year. This is also remarkable in view of the size of the herd. It is a proof, beyond dispute, that the highest care and cleanliness will bring its reward in increased breeding as well as in the improvement of the stock.

Mr. Graves has found labor the chief question on his Farmstead. With the foundation properly laid, in absolute cleanliness and with high grade stock, only ordinary care is necessary if the right caliber of help is available. This is the problem that Mr. Graves is now studying. He desires to obtain plenty of assistance but it must be of the cleanest type. He believes that in time this condition will right itself when more of the model farms are in existence. . In other words the type of farm help will undergo an improvement in the same manner as has the help in every other business.

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WHERE HUMAN LIFE IS CHEAPEST

By C. F. CARTER

ALTHOUGH he may never formulate it in words, the average American cherishes an unalterable belief that, whatever may befall other folk, the angels will always take care of him. Being thus relieved of all responsibility for his own welfare he lacks a personal motive for doing his share toward promoting the public safety. Since what is everybody's business is nobody's business, the rivers continue to be turned into sewers and the lakes into cesspools to poison whole cities at a time, while the fenderless car, the reckless auto, the inflammable building, the overcrowded boat, the unguarded machine, the gas-filled mine and the "forgotten" train order, without let or hindrance, reap on at their dreadful harvest.

So it happens that of all things in this, the most enlightened Nation on earth, human life is cheapest. In his annual report for 1906 Dr. C. J. Whalen, Commissioner of Health for Chicago, made this statement as a fact too familiar to be controverted:

"There are in the United States today approximately eighty millions of people, of whom a million or more will die each year. Of the total number of deaths 25 per cent are unnecessary and could be prevented."

In a recent lecture before the New

THE FACES OF THE WORKMEN IN THIS STEEL ROLLING-MILL ARE SHIELDED AGAINST ANY FLYING PARTICLES OF HOT METAL BY A MASK OF FINE WIRE GAUZE.

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Dust Absorbing Installation in a Comb Factory.
At every working desk a special aspirator absorbs the obnoxious dust, and draws fresh air into the room.

Protection to Eyes and Lungs Against Dust and Other Flying Particles.

York Academy of Medicine Dr. C. A. L. Reed, of Cincinnati, expressed the same idea in another form when he declared that preventable diseases in the United States kill one person every two minutes of the year. At this rate the total would foot up 262,800 lives deliberately thrown away every twelve months. Let him who thinks this startling fact of no concern to himself remember that death is singularly undiscriminating.

Over in Europe, where as mere "subjects" instead of free and independent citizens, human beings are regarded as too valuable to be wasted, some remarkable reductions have been made in the death rate. England and Wales had, in 1903, a death rate of 15.4 per thousand, which was a dcerease of 32.2 per cent from that of the preceding decade. The Netherlands, with a rate of 15.6 showed a decrease of 11 per cent; Denmark, 15.8, a decrease of 9.7; Holland, 17.2, a decrease of 6.5 per cent. Even Sweden, where self preservation had already become a religion, had been able to secure a decrease of 5.6 per cent, bringing her rate down to the remarkably low figure of 15.1 per thousand.

The ten great cities of Copenhagen, Stockholm, Brussels, Amsterdam, London, Berlin, Paris, Vienna, Rome and St. Petersburg in 1904 had an average death rate of 17.1, which was a reduction of 10 per cent in ten years. This average would have been lower if unspeakable St. Petersburg with its rate of 23.7 had been omitted. In the United States the six cities of Chicago, St. Louis, Boston, Philadelphia, Baltimore and New York showed an average rate of 17.9, a reduction of only 6.3 in a decade.

But the most astounding thing is that while the death rate in Europe continues to decline it has turned about and is on the increase here. The United States Census Bureau, which may be presumed

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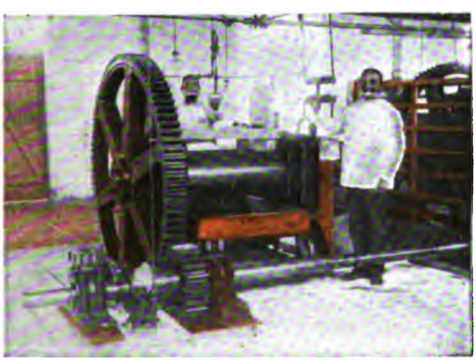
to be unprejudiced, presents figures to show that in twenty-five out of thirty-six large cities the death rate was higher in 1906 than in 1905, and in nine of them it was higher than it had been in five years.

Guard for the Timber Cutter.
The blade of the saw is surrounded with sheet iron. The saw travels back and forth 200 times in a minute.

How such a showing is achieved is set forth in the Mortality Statistics of the Census Bureau for 1906, the latest available. Typhoid fever may be taken as the typical representative of preventable disease, for its nature and means of prevention are so clearly understood that to permit people to become infected wholesale, as they so frequently are, by typhoid is very much like feeding them strychnine with homicidal intent. For the five years from 1901 to 1906 the average death rate from typhoid in Norway was 5.7 per 100,000; in Switzerland, 6.5; in Germany, 7.6; in Japan, 11.4; in the United Kingdom, 12.1; for the registration area of the United States, 32.2, or six times the rate in Norway, four and a half times the rate in Germany and nearly three times the rate in England.



The Throat and Nose Respiratory Protective Device in Use in a Machine Room.

But there are degrees in criminal indifference as in everything else. By the typhoid fever test human life is held cheaper in Pittsburg than anywhere else on the face of the globe, for the death rate from that preventable disease averaged 129.6 per 100,000 population for the five years ending with 1906, the highest in the civilized world. Pueblo, Colorado, stood second in this catalogue of shame with a rate of 113.6; Allegheny third, 110.1; Jacksonville, Florida, 76.3; Columbus, Ohio, 72.3; Louisville, Ky., 67.6. And typhoid is but one of the preventable diseases.

Still, the most damning evidence of the light regard in which human life is held in this free and enlightened country is not to be found in the statistics of preventable disease, black as they are, but in the long roll of death by violence. Disease works by stealth in the darkened chamber out of sight of all but a few. But Violence seeks crowds where in the full glare of noonday he strikes down his victims with all the bloody ferocity of an Indian massacre. Such fearsome spectacles might be supposed to stimulate precautions to prevent their recurrence, for death by violence is more easily preventable than in its more insidious shape of disease, and as a matter of fact is prevented in Europe so effectively that the average death rate by violence in Germany, a manufacturing nation, as long ago as the period from 1887 to 1893 was 37.5 per 100,000; in France, 32.9; in Denmark, 22.5. Note the difference.

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A STONE QUARRY. FROM WHICH THE MATERIAL IS CUT IN SUCH A WAY THAT TERRACES ARE FORMED. RENDERING THE WORK LESS HAZARDOUS.
The stone is then removed by means of inclined planes and electric hoists.

According to the mortality statistics of the Census Bureau for 1906 deaths from all forms of violence in the registration area in 1906 aggregated 49,552. This is at the rate of 120.9 per 100,000 as compared with a rate of 30.1 in the German Empire in the same year. Nor is this all. The rate exceeds that of 1905, which was 111.9, and greatly exceeds that of any preceding year. The rate rose steadily from 6.1 per cent of all deaths in 1902 to 7.5 per cent in 1906. Violence now ranks fifth among the principal causes of death, and the rate is still increasing.

Impressive as the total is it must be remembered that the figures are only for the registration area, which includes the States of California, Colorado, Connecticut, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Dakota and Vermont, and enough cities in other States to bring the total up to 48.5 per cent of the population of the country. Of the population represented in the registration area substantially five-eighths are in cities. In the rest of the country human beings are held so very cheap that they are not deemed worth the trouble of recording their entrance into and exit from the world. It seems fair to assume, however, that the same ratio holds good throughout the country. If that is true, then the deaths by violence in the United States in 1906 must have been one hundred thousand.

This is precisely the same in effect as if every soul in Lowell, Mass., or Albany, N. Y., or Portland, Ore., or in the three cities of Rockford, Ills., Superior, Wis., and Topeka, Kan., were to die within a year.

When Mount Pelee blotted out at a breath a city of twenty-five thousand souls seven years ago the whole country was properly shocked. Pages upon pages of double leaded description in the daily papers gave us thrills of comfortable horror. Collections were taken up, benefits were given, relief ships were rushed to the scene and, in short, we acquitted ourselves very creditably.

That was for strangers. But for our own people, of whom four times as many as Pelee smothered are annually slaughtered at our very doors, there is not a

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tear, not a word of compassion, not a cent for the relief of the dependent survivors. Even if the widows and orphans, after heart breaking delays, succeed in establishing in court that the lives of their protectors were sacrificed to guilty negligence the grudging pittance doled out in the name of Justice is pocketed by the lawyers.

Of course the railroads led the slaughter in 1906 as they do today, with a tally of 7,090 killed as compared with 4,485 in 1902, an increase from 14.1 per 100,000 to 17.3. Other principal causes of death by violence with total number of deaths and the rate per 100,000 inhabitants are set forth in the following table; murders, suicides and executions being omitted:

Cause	Rate	Number of Deaths
Railroads	17.3	7,090
Drowning	10.7	4,395
Burns and scalds	8.7	3,585
Fractures and dislocations	7.6	3,116
Accidental poisoning	4.2	1,734
Vehicles and horses	3.7	1,524
Mines and quarries	3.7	1,523
Street cars	3.6	1,488
Asphyxiation	3.1	1,276
Accidental gunshot	2.6	1,074
Sunstroke	1.9	763
Suffocation	1.8	719
Machinery	1.4	565
Freezing	0.5	203
Automobiles	0.4	183
Lightning	0.4	169
Other accidental causes	21.9	8,961
		38,368

One of the curious things about the fearful story of death by violence is that human life is cheapest, not in the large cities, though of course the total number of deaths is greatest there, as the casual observer might suppose, but in the smaller cities. And nowhere are lives held so lightly as in the smaller cities of Pennsylvania. Measured by the deaths by violence human life is cheapest in Butler, Pennsylvania, where the annual

TILTING CROW-BAR FOR REMOVAL OF STRATIFIED QUARRIES.
To excavate, without danger, in quarries where stones are stratified, and for which explosives cannot be applied, the crow-bar is employed as above.

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rate is 379.4 per 100,000 population. Pittston in the same State stands second with a rate of 359.6. Iron Mountain, Mich., is third in rank with a rate of 290.7, then come McKeeskort, Penn., 290.1; Shenandoah, Penn., 278.9; Pottsville, Penn., 276. Pueblo, Col., is seventh in the list with a rate of 269.3. Altogether there are more than a score of small cities, half of them in Pennsylvania, the rest in New Jersey, Massachusetts, Michigan, Ohio, Indiana and Maryland in which the death rate by violence exceeds the highest rate in any large city.

This highest rate for a large city, 190.9 per 100,000, is found in Pittsburg. If to this be added the death rate from typhoid fever and other preventable diseases, Pittsburg may be deemed fairly entitled to such glory as may attach to the fact that human life is held cheaper within its boundaries than in any other civilized community.

The total number of deaths by violence in 1906 and the rate per 100,000 inhabitants from that cause in seventeen of the larger cities are set forth in the following table:

City	Rate	Total Deaths
Pittsburg	190.9	716
New Orleans	135.3	425
Kansas City	126.7	231
Buffalo	123.6	472
Boston	122.5	738
Cincinnati	118.2	408
San Francisco	116.8	429
Greater New York	105.1	4,323
Washington	101.1	311
Philadelphia	100.8	1,453
St. Louis	97.2	631
Chicago	97.0	1,988
Baltimore	95.5	529
Detroit	93.0	331
Milwaukee	69.8	252
Minneapolis	69.8	191
St. Paul	59.9	122
		13,550

Such a limited analysis as is permitted by the classifications of the statistics of death by violence gives rise to some very uncomfortable reflections for the average man. For example, in Chicago violence caused 7.6 per cent of all deaths. This was an increase over the preceding de-

PROTECTIVE DEVICE ON CIRCULAR WOOD SAW TO PUSH FORWARD SMALL BOARDS.

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cade. A great majority of the various causes that contribute to this alarming total are of the sort that the average man is likely to encounter if he ventures beyond his own threshold. The railroad, as always, stands first with a total of 309 railroads and the subways of the metropolis alone killed 444 persons and wounded 35,060. As all the roads combined carried 1,300,000,000 passengers during the year this was a death or an injury for every 36,615 nickels taken in.

CHISELERS AT WORK WITH EYES SHIELDED BY SPECTACLES.

deaths for the city. Next comes falls which caused 283 deaths. Third in rank of causes are the street cars with 167 deaths to their credit. Vehicles and horses, another peril of the street, the seventh in order of importance, caused 95 deaths.

But when it comes to the perils of the street Chicago must give way to New York. In 1908 the street and elevated Automobiles killed 42 and injured 109. As the Census Bureau first made a separate classification of mortality from street car and automobile accidents in 1906, and as most of the cities do not make separate items of these causes comparisons are impossible.

The most appalling fact connected with the whole bloody business is that one-half of the slaughter is preventable.

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No more convincing evidence on this point is needed than the fact that in Europe such human sacrifices are prevented.

Take the railroads, for instance: Speaking of the country as a whole, travel and employment was safest on American railroads in 1895, when only one trainman in each 155 was killed and one passenger out of each 2,984,832 met a like fate. The death rate increased steadily year by year until in 1903 one employe in every 123 and one passenger in every 1,957,441 were killed. In the United Kingdom that year one employe out of 1,324 and one passenger out of every 198,036,545 were killed. In other words a passenger on a British railroad had a hundred chances to get to his destination alive to every one chance that a traveler on an American railroad had, while the British employe had eleven chances for his life to the American trainman's one.

LIFTING CRUCIBLES FILLED WITH MOLTEN METAL.
A tongue is fastened to a chain which runs over a fixed pulley to a wheel and axle. The workman handling the tongue wears gloves, apron and gaiters of asbestos; his companion, who turns the crank, also wears apron and gaiters of that material.

Employes of American railroads stand a very poor show of dying a natural death. Statistics show that 68.7 per cent of all deaths of brakemen in the decade ending with 1906 were due to accidents while on duty. Railroad firemen had the next most perilous calling, for 53.6 per cent of all who died in the same period were killed while on duty. The proportionate mortality among engineers was 29.6 per cent of all deaths and of conductors 29.2 per cent. The manufacture of explosives, a spectacularly perilous calling, is child's play to any kind of railroad work, for the proportion of violent deaths to all deaths among employes in this business is only 14.1 per cent. Including all classes of railroad employes the death rate from accident was 250 per hundred thousand in the decade from 1897 to 1906 as compared with 98 per hundred thousand in the German empire. To reduce the rate of slaughter in America to the German level would save 1,735 lives each year.

In coal mining, too, there is a startling disparity between the figures for the United States and Europe. From 1890 to 1906 inclusive 22,840 men were killed in the coal mines of the United States. There was a steady increase in the ratio of fatal accidents from 2.67 per thousand men employed in 1875 to 3.40 per thousand employed in 1906. The life of the miner was valued more lightly in Utah than in any other State, for in the decade from 1897 to 1906 the fatalities per thousand men employed reached the amazing rate of 16.57. Indian Territory stood second with a death rate of 6.12 per thousand men employed. New Mexico third, 5.95; Washington fourth, 5.60, and Tennessee sixth with 5 killed annually per thousand men employed.

In startling contrast with this fearful and ever growing record Belgium shows a steady, consecutive decrease in the number of miners killed from an average of 3.28 per thousand employed in the decade from 1851 to 1860 down to only .94 per thousand in 1906. In the coal mines of Great Britain there has also been a steady decrease in the num-

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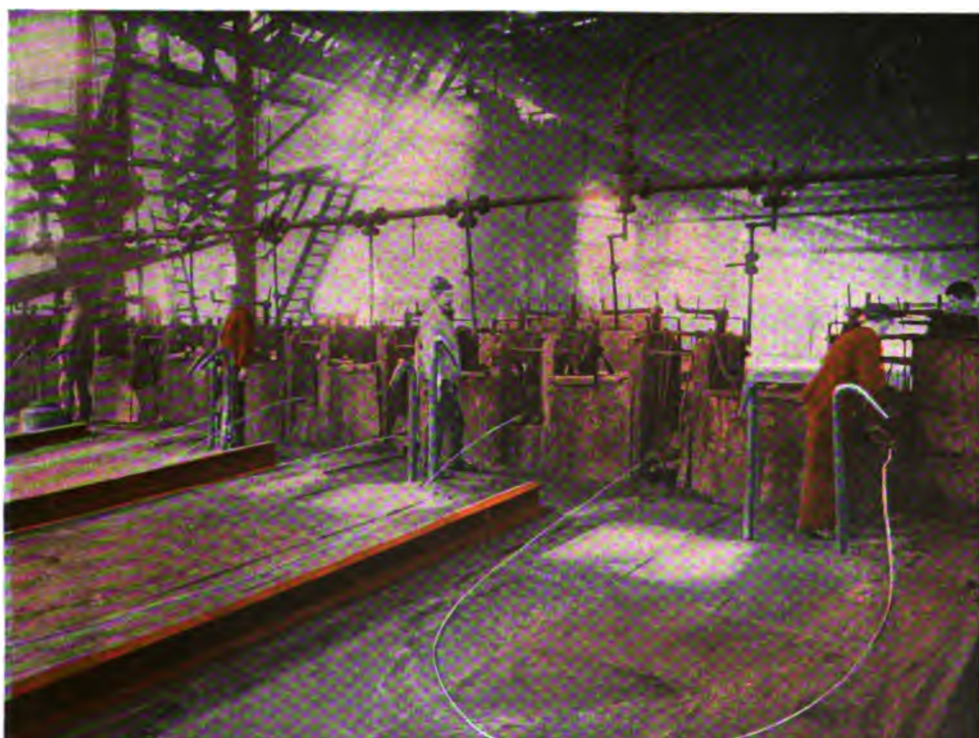
ber killed from 1.50 employed in 1891 to 1.29 per thousand in 1906. In Prussia the fatal accident rate has been forced down from 2.86 per thousand employed in 1898 to 1.80 per thousand in 1904. France leads the world with a record of 1.03 killed per thousand employed in 1901 reduced to .84 per thousand in 1905.

All this has been accomplished in spite of the fact that mining conditions are far more difficult in Europe than here. Indeed, the natural conditions are more favorable in the United States for getting out coal with a minimum amount of danger to the miners than in any other country in the world; and yet the death rate is more than three times as large here as in Europe where the difficulties are greater. The rate still increases here while it continues to decrease in Europe.

The lives of quarrymen, too, are recklessly wasted. Of the total number of deaths among men of this calling 26.3 per cent are due to accidents.

Yet the foregoing statistics do not tell the whole of this story of wasted lives. A recent bulletin of the United States Bureau of Labor estimates the number of occupied males 15 years of age or over killed by accident in the year ending June 1, 1908, at thirty thousand to thirty-five thousand. Of every one hundred deaths from all causes among this class 9.1 were the result of accident, but the mortality differs materially according to age and occupation. Between the ages of 15 and 24 the proportion of accidental deaths to all deaths is 18.2 per cent; between the ages of 25 and 34 15.3 per cent; 35 to 44 years, 13 per cent. The average age at death by accident is 33.5 years, at which age the expectation of life is about twenty-nine years. In other words, this fearful drain occurs where it can least be spared; that is, among the men doing the work of the world before they have reached the prime of life and the maximum of efficiency.



GUARDING THE WIRE-WORKERS.
To protect the men against wounds from the wires, iron tubes bent at the upper end, are erected in front of each bench.

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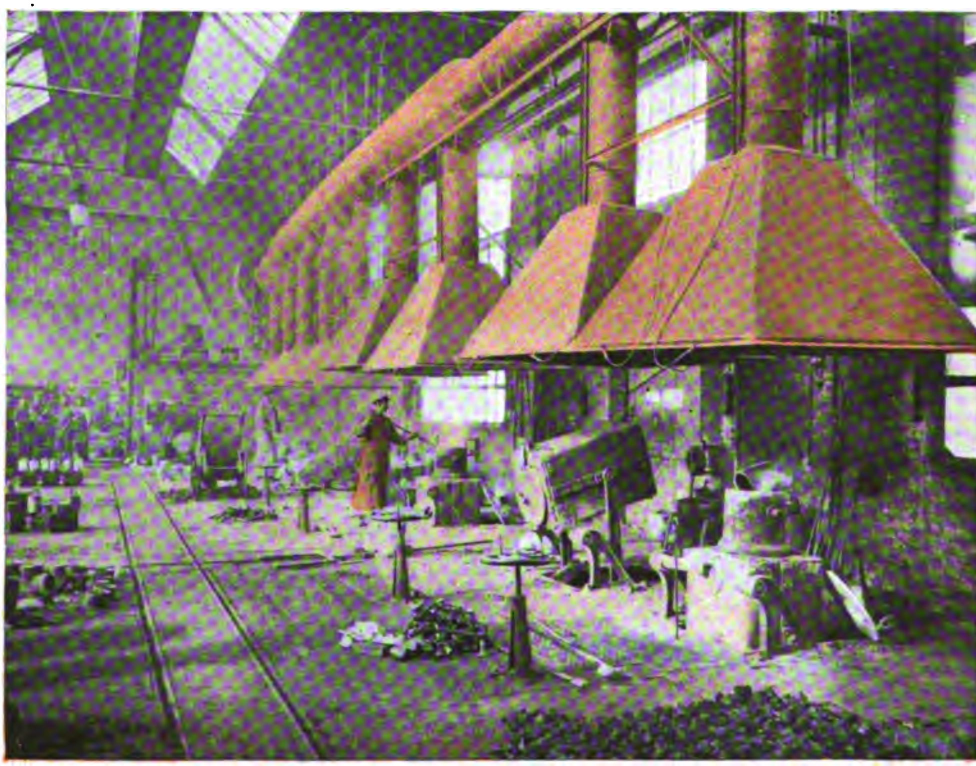
Still this is not all. Of the 39,244 industrial accidents reported by the factory inspectors in New York from 1901 to 1906, 864 or 2.2 per cent were fatal, while 6,580, or 16.8 per cent, resulted in permanent disability. If this ratio of death to permanent disability holds good throughout the country, 240,000 young men were disabled for life last year. their occurrence, yet which inexorably impair the health, curtail the usefulness and shorten the lives of their victims.

Finally there must be added the most numerous class of all, the accidents which result in temporary disability only. The U. S. Bureau of Labor estimates that there "were approximately not much less than two million non-fatal



FURNACES FOR SMELTING METALS WITH SUCTION ARRANGEMENT FOR CARRYING OFF THE POISONOUS FUMES.

These added to the killed make the grand total of young workers removed from the economic assets of the nation last year 315,000. Such an enormous drain upon its very best blood is enough to ruin any nation, even though it boasts of being the greatest and most progressive on earth.

But there is more yet. On top of all this mountain of horror must still be piled the great number of accidents which do not result fatally or in permanent disability, and which may not be regarded as very serious at the time of accidents for the year ending June 1, 1908."

In order to be well within bounds, let it be assumed that the number of non-fatal accidents aggregated only 1,500,000; that means that an average of one out of every 58 persons in the estimated population of 86,895,359 was injured within the year. That brings the chance of accident uncomfortably close, doesn't it?

The grand total of pain and misery represented is something appalling. Nor are the victims the only sufferers. Wages

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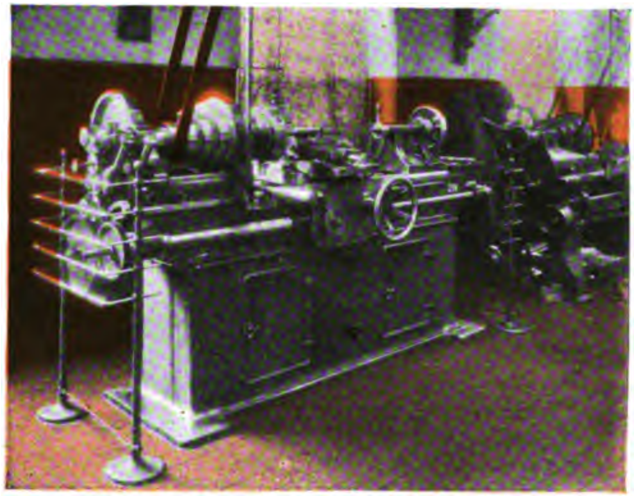
stop when the head of the family goes to the hospital, and he may go when his earnings can least be spared. Still, bereavement and pain and want are strictly private and personal feelings in which the public can not be expected to share. There is only one way to express this perpetual massacre in intelligible terms, and that is in dollars and cents.

Let us, then, multiply the estimated total of men annually killed or permanently disabled, 315,000, by $600 as the average annual earnings of the victims. As the list includes skilled workmen and men of affairs this may be considered conservative. The product is a yearly earning power of $189,000,000 permanently lost to the country.

To this vast sum must be added the time lost by the 1,500,000 men temporarily disabled. The Wisconsin Labor Bureau found that 48 per cent of the injured in accidents in that State lost at least two weeks' time and 14 per cent lost from four to eight weeks' time. The Illinois Labor Bureau found that the average time lost by miners injured in accidents in that State was 54.7 days. To assume, therefore, an average of three weeks' time lost for the total would be fairly conservative. On this basis the time lost at $600 a year would amount to $52,000,000, which added to the loss by death and permanent disability would make a grand total of $241,000,000 as the loss of earning power to be charged against accidents annually.

If this stupendous economic waste were to be reduced one-half through the adoption of safety devices such as are in general use in Europe and by the enforcing of common sense laws and regulations the money saving would amount to $120,500,000 a year—a sum that would very quickly provide the comprehensive system of inland water-



End Wheel Guards Consisting of Curved Rods, Which Prevent the Accidental Catching of Hands or Clothes Between the Cogs.

ways with more than "fourteen feet through the valley" so ardently desired by persons with freight to move, not to mention an inconceivable amount of suffering and privation—but that concerns only the victims and their families.

We have had a national conference on the conservation of natural resources at which much lofty eloquence was unlimbered in behalf of the insensate soil, water, minerals and timber; yet not a syllable has been heard about conserving the life blood of the people for whom this material wealth is to be saved.

But then, perhaps, human life is too cheap to be worth the saving.

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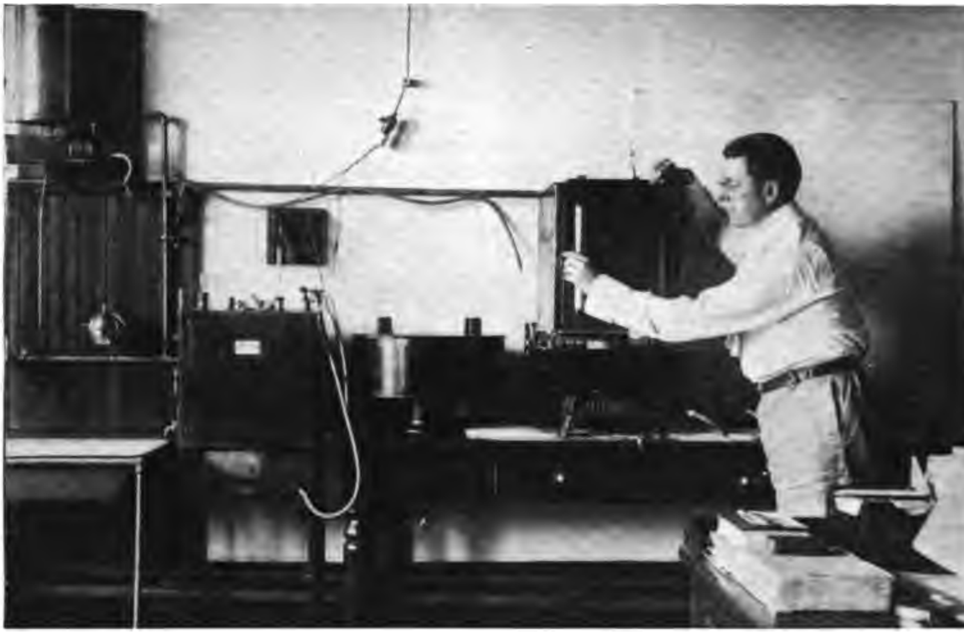

APPARATUS FOR BREEDING AND KILLING TYPHOID BACILLI. AT THE ARMY MEDICAL MUSEUM IN WASHINGTON.

TYPHOID FEVER CONQUERED

By RENE BACHE

Typhoid fever, as well as small-pox, may be prevented by the use of a vaccine. The persons associated with the working out of this problem are Sir A. E. Wright, of London (who first applied the method); Colonel Leishman and Major Harrison, both of the Royal Army Medical Corps of Great Britain; Professor Kolle, of Berne, and Professor Pfeiffer, of Konigsberg, Prussia. The two last-named have worked under the direction of the German war department. In this country the experiments have been made at the Army Medical Museum, in Washington, under the direction of Major F. F. Russell.

FROM this time on it is merely a question whether one wishes to be proof against attack by typhoid fever or not. Certainly there can be no reason for contracting the malady unless one chooses.

People nowadays do not "catch" smallpox if they have been properly vaccinated. In case they neglect that customary precaution, it is considered that they have deliberately exposed themselves to the risk of contagion. The same proposition will in future apply to typhoid, inasmuch as means have been found whereby, through inoculation with a suitable "vaccine," anybody may be rendered permanently immune—that is to say, incapable of acquiring the disease.

Typhoid in old times was known as "putrid fever." It was one of the most deadly of human maladies, largely because the proper methods to adopt in dealing with it were not yet known. But even today, when it kills less than ten per cent of the victims it assails, it is exceedingly destructive. It caused eighty per cent of the total deaths on the American side during the war with Spain—the disease, which raged in the military

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camps, being distributed chiefly by flies. And it was recently estimated by Dr. George M. Kober, of Washington, D. C. —a recognized authority on the subject —that, reckoning loss of wage-earning capacity, expense for medical attendance, etc., typhoid fever in this country costs annually not less than $350,000,000.

Accepting these figures, it appears that this disease costs the people of the United States more than a billion dollars every three years. The price really seems too high. How is it to be lessened? It is a problem which medical men have long sought to solve, but without much success hitherto. What with infected water and food, and the ever-present house-fly to help distribute the germs, it has seemed impossible to keep the infection out of people's systems. The best that could be done was to treat the stricken by scientific methods, good nursing and a liquid diet being the principal requirements.

Glass Tube Made to Contain One Dose of Typhoid Vaccine.

There is just one advantage in having typhoid. An attack of it renders one immune to the complaint thereafter—at all events, practically so, inasmuch as a recurrence of the malady in a person who has once recovered from it is almost unknown. But it would surely be very advantageous if such immunity could be attained without going through the sickness and suffering, with incidental risk of dying.

Fortunately, this very thing has at last been accomplished. That is to say, a means has been discovered whereby anybody may be rendered immune to typhoid —the result being obtained by a simple process of vaccination. An immunizing fluid, prepared in a manner presently to be described, is injected with a hypodermic syringe beneath the skin of the arm. A slight local irritation is set up, such as that caused by vaccination for smallpox, though less severe; a slight malaise and languor are felt for a few days, and that is all. Thenceforward the individual is typhoid-proof.

The principle of vaccination for smallpox is that of utilizing the germ of a nearly-related disease of the cow, much milder in character, to produce immunity against the more serious malady. This idea nowadays is beginning to be applied, with much success, to other maladies, notably rabies—by Pasteur's discovery—and cholera and bubonic plague, the two latter at the instance of Haffkine, an Englishman. Vaccination for typhoid—first worked out by Sir A. E. Wright, of London—is based upon the same theory.

For some time past our own War Department has been busily engaged with the problem of typhoid vaccination, and at the Army Medical Museum, in Washington, large quantities of the immunizing fluid have been manufactured and put up in sealed glass tubes, ready for use—each tube containing the few drops requisite for a dose. For military purposes, it is of utmost importance to find a means whereby the "putrid fever," which has always been the most deadly enemy of troops — commonly killing more men than were slain by the enemy—shall be robbed of its power to destroy.

There is no reason, indeed, why our soldiers in the field, in future wars, should suffer any loss whatever by typhoid. It will doubtless be required of every recruit, as a matter of course, that, before being finally accepted, he shall be immunized against the malady. As for the regular army, several hundred men, volunteering for the purpose, have already been inoculated; and, the investigation having now passed beyond the experimental stage, every officer and enlisted man will be subjected to the treatment.

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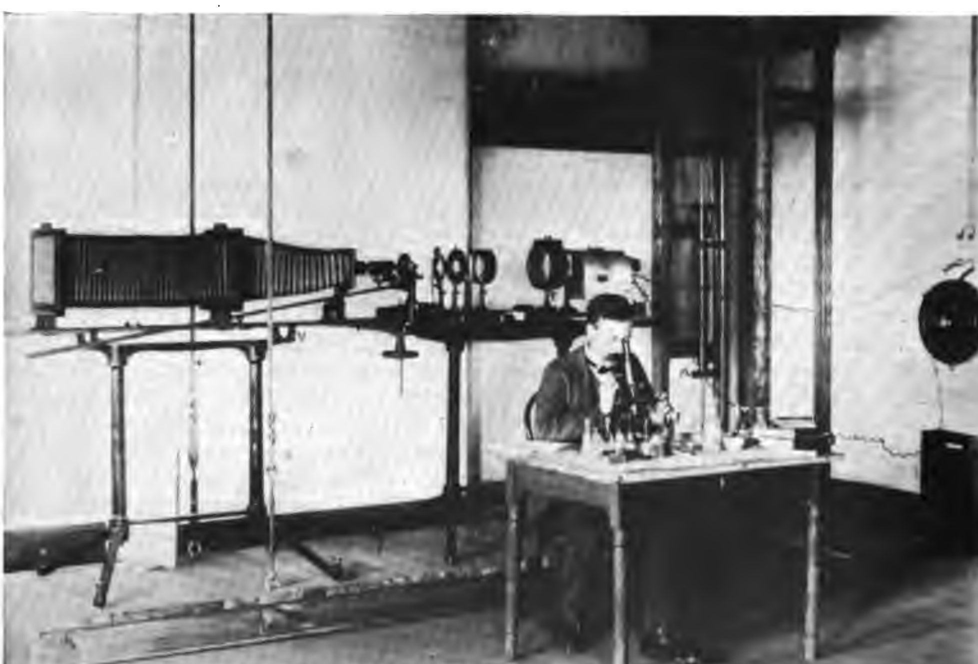
The "vaccine" for typhoid is prepared by an extremely simple process. A quantity of beef broth is made, and, when it has had time to cool, a few typhoid bacilli are put into it. Finding it an acceptable food, they multiply with great rapidity, until, after a few hours, the vessel of soup contains countless billions of them. They are then killed by putting the broth into a sort of oven and heating it to a point in the neighborhood of boiling.

INSTRUMENTS USED AT THE ARMY MEDICAL MUSEUM FOR HANDLING TYPHOID VACCINE.

This is the "vaccine"—a soup containing the dead bodies of billions of typhoid bacilli. It is now ready for use. But first, to make perfectly sure that all the bacilli are dead, a small quantity of the soup is put into a fresh batch of broth, previously sterilized by heat. If, on microscopic examination, some hours later, no living bacilli are found in the new broth, it is taken for granted that the stuff is all right, and the soup holding the defunct germs is put up in little glass tubes. Each tube, after being sterilized, receives a certain number of drops of the immunizing fluid from a machine made for the purpose, and is then hermetically sealed with a glass-blower's blowpipe. It thus becomes nothing more than an elongated bulb of glass, with no opening through which any



EXAMINING A SAMPLE OF TYPHOID VACCINE UNDER THE MICROSCOPE.

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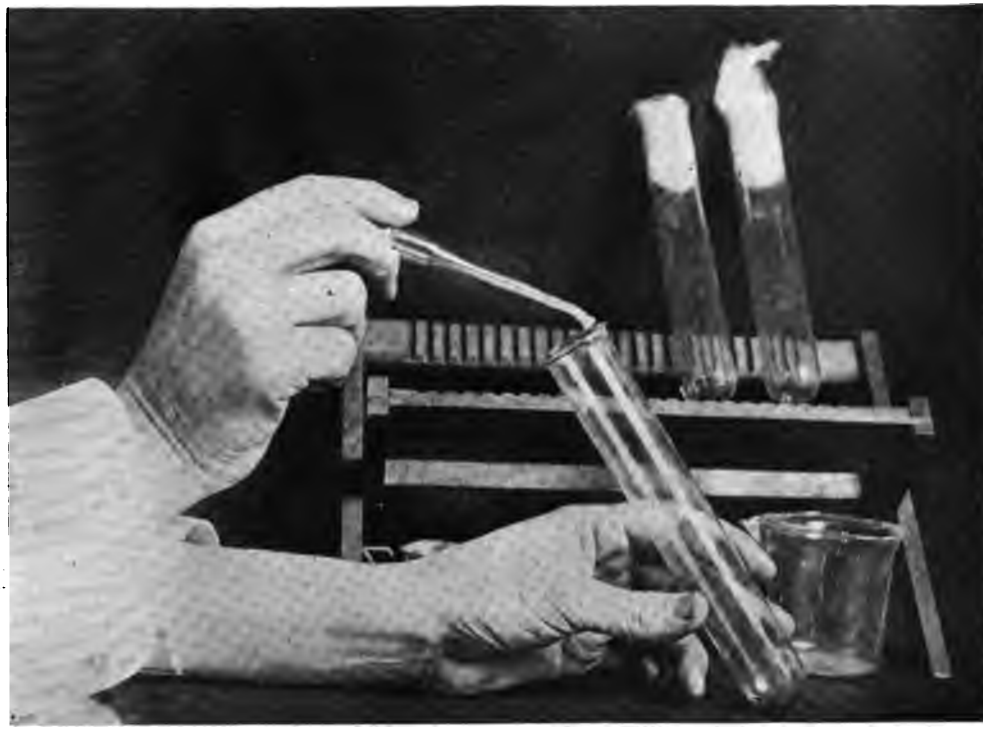

PREPARING A CULTURE OF TYPHOID GERMS.

microbe can gain admittance. When a dose is to be administered, the physician simply breaks off one end of the tube, draws its contents into his hypodermic syringe—previously sterilized—and thrusts the point of the instrument beneath the skin of the person to be inoculated. A brief squirt, and it is all over. But, to make assurance doubly sure—to make certain, that is to say, of "taking"—a second dose is usually administered. The first one is of eight drops, representing about 500,000,000 bacilli; the second is fifteen drops, containing 1,000,000,000 bacilli, or thereabouts.

But, as already explained, the bacilli are all dead. Why, then, should they possess any usefulness? The answer is that, though defunct, they still contain the peculiar and characteristic poison belonging to this species of microbes. They are powerless to engender typhoid fever in the human body, but the poison in question has the effect of inducing the cells of the body to manufacture a particular antidote—the antidote to typhoid.

TYPHOID FEVER GERMS, GREATLY MAGNIFIED.

When a person is attacked by typhoid fever, the germs, feeding on the tissues, incidentally set free a considerable quantity of their specific poison. This poison is injurious to the body cells, which absorb more

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TAKING A SAMPLE OF BLOOD FOR BACTERIOLOGICAL EXAMINATION.

or less of it. But the cells, to protect themselves against the enemy, proceed to manufacture on their own account an anti-poison—that is to say, a substance which in nine cases out of ten—if the patient be properly cared for—kills off the hostile microbes, and eventually drives them out of the system. This is what happens every time when a sufferer from typhoid recovers.

One would naturally suppose that, after killing off the enemy, the cells would stop manufacturing the anti-poison. As a matter of fact, they do not. They continue to turn it out in quantities, and keep on doing so for the rest of their lives. Thus, if at any time afterwards an attempt is made by typhoid germs to attack the citadel of the body, they are killed off before they have time to multiply in numbers sufficient to be dangerous. No matter how many of the bacilli may enter his system, the person who has recovered from typhoid is safe against it. He is incapable of taking the disease.

Now, when a person is inoculated with the typhoid "vaccine," exactly the same thing is accomplished—but without sickness or danger of death. The specific poison, thus introduced into the system, gives alarm, apparently, to the body cells, and starts them to manufacturing with all possible rapidity the anti-poison. Having once begun to make it, they continue to do so throughout the lifetime of

INOCULATING GELATIN IN A GLASS TUBE WITH GERMS OF TYPHOID.

the individual, so that he is rendered forevermore immune.

It has already been said that this great medical discovery has passed beyond the experimental stage. Up to now the work in this country has been carried on exclusively, and very quietly, by the War Department. The "vaccine" has been manufactured at the Army Medical Museum, in Washington, which possesses a superb bacteriological plant. Very soon, however, the stuff will be put up in quantities by the great drug firms, and will be sold by apothecaries, for use by physicians. Thus it will be rendered ac-

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cessible to the public at large; and it is reasonable to expect that the use of it will become as much a matter of course as that of vaccine for smallpox prevention.

If a small quantity of blood be drawn from the veins of a person who has been inoculated in the manner described, and allowed to stand for a short time in a suitable vessel, the red corpuscles will settle to the bottom, being heavier, while the colorless watery fluid, called "serum," remains on top. The serum may then be separated from the red portion very easily, by pouring it off carefully. This is exactly what would happen with anybody's blood. But the remarkable fact is that the serum of the person vaccinated for typhoid is itself deadly to typhoid germs, killing them quickly and surely.

Vaccination for typhoid represents only one step in an advance which the science of medicine is making along new lines. Before long many of the worst diseases to which human flesh is heir will be dealt with by preventive measures based upon the same fundamental principle. Already efforts are being made to utilize the same principle in dealing with the most dreaded and destructive of all maladies, tuberculosis. This disease in cattle is being most successfully treated by the use of a "vaccine" obtained from human tubercle bacilli, which, it seems, are much less virulent than the bovine kind. But, for some reason unknown, this sort of vaccine is too strong for human beings. What is wanted—and physicians are looking for it eagerly—is some sort of tubercle microbe—possibly to be obtained from some one of the lower animals—which shall be milder than the human variety, and which may be expected to produce immunity to consumption and other forms of tuberculosis, just as the germs of cowpox render people incapable of contracting the much deadlier disease of smallpox.

A Toast

I fill this cup to one made up
Of loveliness alone,
A woman, of her gentle sex
The seeming paragon—
Her health! and would on earth there stood
Some more of such a frame
That life might be all poetry,
And weariness a name.

—E. C. Pinckney.

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WHO OWNS THE EARTH?
V. The Fat Jack of the Coal Mines

By HENRY M. HYDE.

SUPPOSE that the total food supply of the world consisted of one thousand carefully counted Christmas pies. Suppose that little Jack Horner had the thousand pies all tucked away in his cupboard. Suppose that every morning in the year, fat Jack, sitting snug in his corner, thrust his thumb into one of the pastries and pulled out a few plums, which he sold to a hungry world at a price which increased with each rising of the sun. Suppose all the rest of the pie—the plums being carelessly extracted—Jack threw into the garbage can, where it yielded sustenance to not even a gaunt and predatory dog.

How long would you be content to pay Jack his price? How long would it be before you would at least force him to put all of each pie on the market? How long would you be willing to pull your belly-band tighter to stop the pangs of hunger and forget your own discomfort in admiration of Jack's magnificent, if somewhat flabby, corpulency?

A nice, easy, one-syllable, nursery parallel of this kind seems necessary to fix the attention of a childish public, even for a casual moment, on the Fat Jack of the coal mines of the United States.

Not even the wisest geologists know how many thousands of years it takes nature to turn vegetable matter into coal. Therefore, when the present supply of crystallized carbon is exhausted it seems fairly certain that it will be some little time before another crop is ready for the digging. If the present increasing rate of consumption of our present deposits continues—it is practically certain to grow more rapidly, rather than lessen—all the anthracite coal in the United States will be gone in fifty years and all the bituminous in a little more than a hundred years. This statement is made on the authority of Gifford Pinchot, Chief of the Forest Service, and is endorsed by all the unprejudiced and competent scientists who have studied the question.

So, at the end of a hundred years, dear children, all the coal will be gone AND THERE WILL NEVER BE ANY MORE COAL IN THE UNITED STATES.

This is the proper place for the cheerful idiot to show his American sense of humor by remarking that anyway his grandson won't have to carry any more heavy scuttles up from the cellar or sift the ashes from the furnace. Which is very true as well as witty. His grandson's family will, instead, sit shivering around a tin pan, with three square

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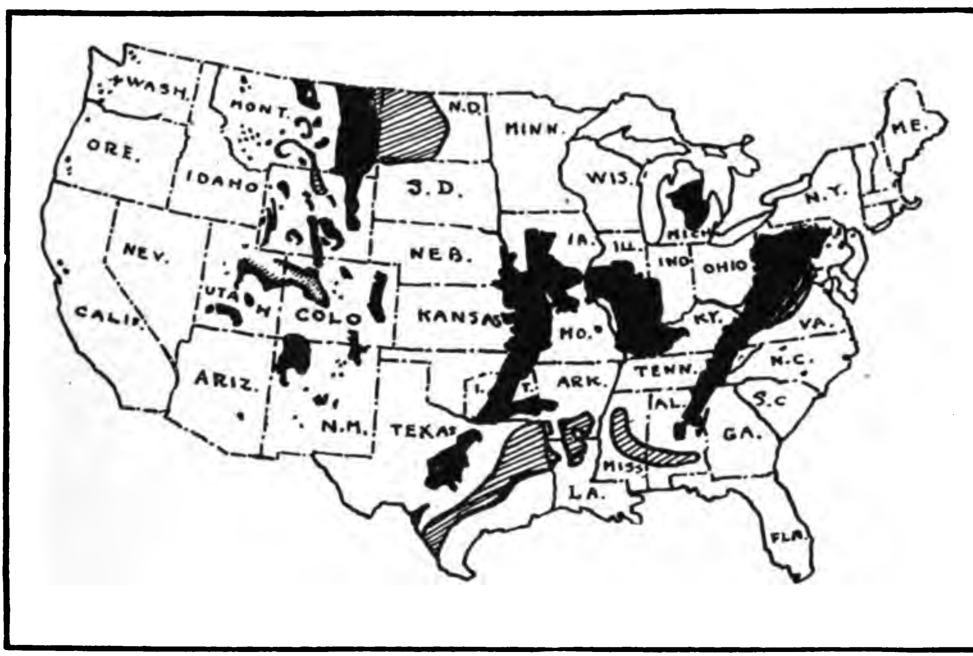
inches of smouldering charcoal in it, as the peasants do today in Italy. And, when one comes to think of it, shivering as a family amusement is better fitted to the climate of Italy than to that of the northern part of the United States. It would be difficult for anybody's grandchildren to shiver picturesquely with a good ten-degree-below blizzard sweeping across the prairies.

Well, WHAT ARE YOU GOING TO DO ABOUT IT?

You will remember, children, that little Jack Horner, with the laudable ambition of getting the most out of a good thing in the quickest time, was in the habit of carefully inserting his thumb into the Christmas pie and extracting only the plums. That is exactly the policy which is followed in the operation of every coal mine in the United States. The private corporation which owns the coal lands, operating without the slightest governmental supervision or control and actuated only by a desire to pay the largest possible dividends, sinks a shaft or two for exploring purposes and has charts drawn which show the various strata of coal deposits which underlie its holdings. At ten feet below the surface there is a layer of coal ten feet wide; twelve feet lower is a second layer nine feet wide; at thirty feet down there is a great stratum of the finest quality which measures twenty-five feet. The lowest layer is the thickest and richest and therefore the most profitable to work. There the miners are promptly set to work. Sooner or later the coal is taken out of this great deposit and the workings abandoned, leaving great cavities in the earth. Presently the roof of these abandoned mines gives way and breaks down. The surface of the ground above caves in and is broken into a chaos of twisted gulleys and pits. The two upper layers of coal are forever rendered unworkable in the process.



THE COAL REGIONS OF THE UNITED STATES.
The black areas are anthracite and bituminous; the shaded areas are lignite.

But even that isn't plum enough for little Jack Horner. Of the twenty-five foot layer which he has mined, the middle twelve feet is of a purer and finer grade than the rest. So he digs only that, leaving more than six feet on either

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side of the coal actually removed to go to ruin when the mine is abandoned. The plum parallel seems to be pretty accurate, doesn't it? But really one doesn't yet appreciate Jack's appetite for sweetmeats. The best American coal mining practice leaves great pillars and braces of solid coal to support the roof while the miners are at work. That is cheaper than supporting the roof by artificial braces and, really, what does it matter that less than half of the coal is taken out when one considers our absolutely inexhaustible natural resources! Besides see how fat happy little Jack has got on an exclusive diet of plums!

Specific instances? In Montana there is a great deposit of coal known as the Wideman mine. The coal-seam is twenty-five feet wide and only four feet of it are being mined and taken out. In the Pennsylvania coal-fields there is a coal stratum known as the Swickley seam. It is five or six feet thick and of good quality, but it will never be mined. It has been absolutely ruined and practically destroyed by the mining of lower strata and the consequent caving-in of the earth. Look around in any coal-field which has been worked for any considerable length of time and you will find more than enough ruined coal deposits to make you wonder how God likes a people so criminally reckless that they permit to be wantonly and uselessly destroyed in a few years what it has taken Him aeons to create.

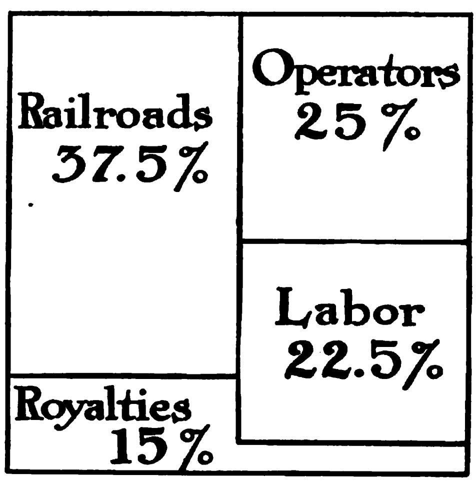

DIAGRAM SHOWING THE DIVISION OF PROFITS IN THE COAL INDUSTRY UP TO THE TIME THE TRUST SECURED CONTROL.
The figures are based on government statistics.

If the mine owners of the United States were required by law to take out all of the available fuel, the coal supply would last more than twice as long as it will under present conditions.

But, WHAT ARE YOU GOING TO DO ABOUT IT?

Government control of—H E L P! HELP! Listen, dear children, to the clarion voice of Uncle Joseph Cannon calling his fellow patriots to defend the Republic against the dastardly attacks of those who would undermine the Bulwarks of our Liberties and pull the tail feathers out of the ever-glorious and untrammelled Bird of Freedom! BOO! Look out behind you at the Boogy Man of Socialism, while fat and smiling Jack, with no moustache to deceive you, helps himself to a few thousand more acres of public coal lands!

BUT, as I was about to remark, when the Boogy Man scared me, THE GREAT HEART OF HUMANITY BEATS WITH AN UNFETTERED TIDE FROM THE STERN NEW ENGLAND COAST TO WHERE THE PALMS DROOP LANGUIDLY IN THE TROPIC AIR OF FLORIDA AND OVER ALL FLOATS THE GLORIOUS BANNER OF FREEDOM, UNDER WHOSE STAINLESS FOLDS—why, of course we object to being investigated by the government secret service officers. Several of us have been caught at it already and—STAINLESS FOLDS, WHICH HAVE BEEN DYED IN THE HEART'S BLOOD OF A MILLION FREEMEN AND—.

The effete empire of Germany, dear children, where fat Jack has been eating the plums for several years longer than in this country, has spent $71,000,000 to buy back coal lands from private owners. Up in Canada, which, as you will be eloquently told under the great dome of the capitol, is merely a belated dependency of the obsolete and archaic kingdom of Great Britain, they have withdrawn all the coal lands still remain-

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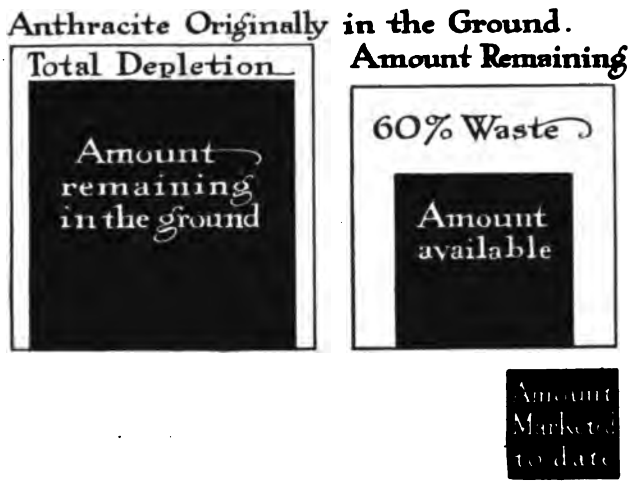
ing in the public domain from settlement —greatly to the distress of the enterprising and patriotic corporations, which have done so much to open up—not to say disembowel—the far West of the United States—and are leasing these lands to private mine operators, who take out the coal under the watchful supervision of government inspectors. And, dear little children, pray notice carefully that from these Canadian mines, worked under government control, 98 per cent of all the available coal is removed and put to a useful purpose, as opposed to less than fifty per cent in the privately owned and operated mines of the United States.

And now, children, gather closely about and I will tell you a secret. In the year 1907 Theodore Roosevelt, President of the United States, also withdrew from sale and entry no less than seventy-one million acres of the public lands which are underlaid with coal deposits. Mr. Roosevelt even wished to follow the Canadian example of leasing these lands to private corporations to be operated economically under government supervision, so that all the coal should be saved and, at the same time, a handsome annual revenue obtained which should help to pay the running expenses of this billion dollar government and, to that extent, cut down the necessary taxes.

Be very careful, children, not to repeat this so that word of it shall get to your old Uncle Joseph, for he is very nervous, and startling news of this kind is likely to make him lose control of his vocal organs. If you will only keep quiet and not make the slightest noise for a little while, you know that Mr. Roosevelt has gone away for a long, long time and, if the lions do their duty, perhaps your good old uncle may be spared the awful agony of seeing anything like that happen. . . . WAH-HOO! OUCH! SOCIALISM! NIHILISM! MURDER! HELP! . . . There, I told you what would happen if you didn't keep perfectly still. Now you have nobody but yourselves to blame. . . . NO LONGER SHALL THE BROAD AND FERTILE PLAINS OF OUR YET UNDEVELOPED BUT IMPERIAL DOMAIN BE DOTTED



A Diagram Which Tells a Story at a Glance.
At the present rate of consumption our coal will be exhausted in another hundred years.

WITH SOD-ROOFS OF OUR GALLANT AND STURDY PIONEERS!

NO LONGER SHALL THE TEEMING MILLIONS WHO COME HITHER FROM KING-CURSED EUROPE FIND FREE ACCESS TO OUR BROAD AND BOUNTEOUS ACRES! THEY WILL BE CONDEMNED TO SWELTER AND STARVE IN THE SWARMING PURLIEUS OF OUR GREAT CITIES, WHILE SOCIALISM, WEARING THE LIVERY OF HIGH OFFICE, SLIPS LIKE A SLIMY SNAKE INTO THE CITADEL OF OUR LIBERTIES AND STRANGLES THE INFANT REPUBLIC IN ITS LOATHSOME FOLDS! . . . (Loud and continued applause from the gathered statesmen.) . . . Well, I reckon that will hold them for a few minutes. Page, hand me the hartshorn bottle . . . and just slip over to the Congressional Library and find out how many varieties of poisonous serpents are

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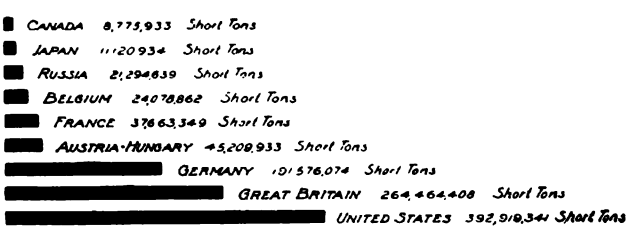
native of South Africa and other warm countries. . . .

And now, children, kindly take your seats. It pains dear teacher very deeply to say that when it comes to wasting coal every one of you is worse than the most piously plump of the coal miners.

Every factory chimney which pours its cloud of black smoke into the air, every locomotive and steamship stack, which vomits soot and cinders over the landscape, flaunts your shameless extravagance to the world. It is, directly speaking, the fault of the little boy in the blue denim jumper, with the coal scoop in his hand. Proper firing and combustion would stop a large part of this particular waste and save a large sum of money for the people who pay for the coal. But we are all trying to make as much money as we can as quickly and as easily as we can. And it is too much to expect a stationary or locomotive fireman to set the rest of us a good example.

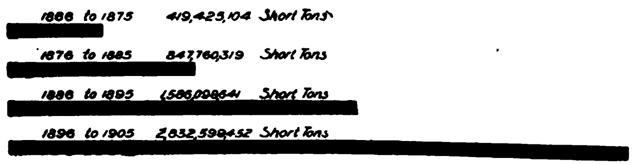
But even under the best conditions and practice only five or six per cent of the total energy contained in the coal burned under stationary steam boilers is actually turned into power. More than ninety per cent of all the coal burned in our factories is actually and absolutely wasted. Nor is that the worst of the story. Locomotive engines are more wasteful still. None of them utilize more than four or five per cent of the energy stored away in the coal they burn.

In other words the steam engine—which is the father and mother and all the ancestors of modern industry and world-progress—is one of the most wasteful and extravagant contrivances ever devised by man.



OUT-PUT OF PRINCIPAL COAL-PRODUCING NATIONS.

Teacher! Teacher! Little Johnny Railroads, with uplifted hand, signifies his desire to make a few pointed remarks. Come right up here on the platform, Johnny, and sit down. Johnny points out that all modern industries are due to the steam engine; he points out all that the railroad locomotive has done to develop the country, to encourage industry, to make the United States the most prosperous and the most intelligent country in the world and he asks, with a scornful smile, if dear teacher really wishes to abolish the steam engine because it wastes a little coal?



HOW COAL CONSUMPTION HAS INCREASED IN THE UNITED STATES.

It would seem to be apparent even to little Johnny's intellect that the steam engine will abolish itself when it has burned up all the coal. How soon will that be? If we continue using up the coal at the increasing rate which has prevailed for the last seventy-five years it will all be gone in about one hundred years. That is the estimate of Gifford Pinchot, who holds the leading brief for the people in the present controversy.

Teacher knows you hate arithmetic, Johnny, but suppose you take out your slate and set down a few figures. In 1880 we mined 71,000,000 tons; in 1890 over 157,000,000 tons; in 1900 nearly 270,000,000 tons and in 1907 about 475,000,000 tons.

Since 1850 the population of the United States has increased about 250 per cent; in the same period the annual production of coal has increased 4,180 per cent. How long will it take to exhaust "absolutely inexhaustible" supplies of anything at that rate of increase?

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But, again, WHAT ARE YOU GOING TO DO ABOUT IT?

Where stationary steam boilers utilize from five to six per cent of the energy contained in the coal burned under them and locomotives less than that, gas producer engines develop more than twice as much power from the same amount of coal. More than that, lignite—an inferior coal which is useless for steam production—is a perfectly good fuel for gas producers. Almost anything which will burn, in fact, may be utilized in the producer gas engine. And gradually steam's new rival is coming into its own. One of the greatest power installations in the world is that of the United States Steel Company in its enormous plant at Gary, Ind. Here gas engines which will produce 100,000 horse-power are already in place. They will burn gas, which until recently has been utterly wasted as it poured in a burning crimson cloud from the tops of the blast furnaces. And 100,000 additional horse-power will be added as it is required.

The turbine water wheel and the electric transmission of power, which make it possible to utilize the hitherto wasted water power of the world, will also take much of the strain off the coal mines. There are now running and in process of erection hydro-electric power plants which will develop millions of horse-power. And—as pointed out in a previous article—it is certain, unless prompt action is taken by the people, that the water power will be controlled by a monopoly vastly more powerful and dangerous than that which at present controls the coal mines of the country.

Modern methods of utilizing coal slack and of putting up peat into briquettes will also make vast additional quantities of fuel available. There are also other vast and practically unused sources of power, which will doubtless be used in the future. The winds, the tides, the direct rays of the sun and the subterranean fires of the earth will all some day help to do the hard work of the world.

It is the business of the scientist, the inventor and the engineer to develop these new sources of power. It is the duty of statesmen to conserve—for the benefit of all the people—the coal deposits, which are still vastly the greatest in the world, and on which for years to come we must rely for heat, light and power.

The task is one worthy of a great constructive statesman. President Taft takes with him to the White House no greater opportunity than this one of coal conservation.

The Beauty of Ages

Round and round, like a dance of snow
In a dazzling drift, as its guardians, go
Floating the women faded for ages,
Sculptured in stone on the poet's pages.

—BROWNING.

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KEEPING AN ORCHARD WARM

By ROLAND ASHFORD PHILLIPS

"PROTECT us against the early frosts," says the fruit grower, "and we'll take chances with anything else."

And with the coming of improved orchard heaters, this demand has been gratified to such an extent that the destruction of a crop by frost will soon be unknown. When a room is cold you heat it. When the fruit grower receives warning of an approaching cold wave he immediately proceeds to heat his orchard in practically the same manner as a person would carry an oil heater into his bedroom. True, smudges, as they were formerly called, had long been known, and crudely put into operation, but no system was ever used, and as a direct consequence their orchards suffered as much from this method as from the frost.

THE PAN HEATER.

PARTS OF THE ORCHARD HEATER.
The simplicity of the device is at once apparent.

The heaters pictured are extremely simple. One, the cylindrical heater, is made up of four parts and stands about two feet high. It is constructed of ordinary stove pipe iron, and the lower can is, in appearance, similar to a ten pound lard pail. This receptacle holds five quarts of oil, and will burn five hours with a large flame. Above this stands the flue, six inches high, five in diameter, and open at both ends. A flat piece of iron, six inches square, is used as a cover for the heater when not in operation, also to extinguish the flame by laying

THE REMAINING PARTS OF THE HEATER.
The various parts can be shipped at a low freight rate under head of "stone mixtures."

over the opening, and lastly, by aid of the hook riveted near the center, is placed upright on the edge of the flue to spread the flame when a breeze is blowing.

The fuel used is what is commonly known as smudge or fuel oil, and can be procured at all refineries for about two and one-half cents a gallon, in car lots. This crude oil burns steadily, gives off a great volume of heat and very little smoke.

Another heater is a coal-burner, constructed in form of a funnel-shaped pan, with draft holes in the center only, so that the fire started there will burn slowly in the midst of the panful of coal and feed itself from the sides where there

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are no draft holes and therefore no fire. This form is as successful as any. It gives a wide radiation very desirable. The pan is covered with a lid to protect the fire. In this form of heater thirty pounds of coal will last six hours and forty to fifty heaters are used per acre. They cost twenty-eight cents each.

Eighty oil heaters to an average acre is recommended, or about one to every tree. Their position also largely depends upon the orchard, for if the trees are large and meet overhead between the rows, the heater should be placed in the center of the square; and, should the trees be small the heater should be placed about three feet from the trunk, and on the windward side. There are numerous methods in which the tanks are filled, but the better way seems to be in driving a loaded wagon down the rows and filling the heater with the aid of a hose.

THE HEATER READY FOR USE.

When filled and ready to light, a small strip of cotton waste or burlap is run through the large two inch hole and allowed to protrude a few inches up the flue. This forms a thick wick and when lighted a strong, white flame is the result.

The two smaller holes in the cover is used for the draught.

The slight cost of several forms of these heaters—from nineteen to thirty cents apiece—puts them in easy reach of even the smallest grower, and the investment, in comparison of the total ruin of a blossoming orchard, is but a trifle.

A very interesting experiment was made last April by a big grower near Grand Junction, Colorado. This man had twenty acres of fifteen year old trees, both peach and apple. These trees stood about twenty feet apart, and their branches, loaded with bursting blossoms, met thickly overhead, making an ideal condition for heating.

When the temperature dropped to thirty he started to light his heaters, the entire field being fired in less than a half-hour. Ten minutes later a thermometer outside of the heated zone showed 29, and one in the orchard center showed 32. From midnight until seven the next morning all heaters were in full operation, and in these seven hours the thermometer outside fell as low as 21, while within the orchard proper an average temperature of 32 was maintained.

The coldest period, and the one most to be dreaded, is the half hour before sunrise. This safely passed the orchard is saved.

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CONSTRUCTING A CONCRETE WALL FOR A HOUSE.

NEW TRIUMPHS OF CONCRETE

By M. M. HUNTING E. C. HALL F. B. WARREN

Concrete Walls First Built Then Raised

TO those who are familiar with the handling of concrete, the Edison method of constructing an entire house at a single pouring, seems like a visionary one, but a system seemingly as impractical whereby the walls of a building are moulded one at a time, flat on the ground, and then tilted into place has been tried and found successful.

A two story mess hall has been built for the state troops at Camp Perry, Ohio, by this method, and so successful has it been found that the National Government is now considering this form of construction for other buildings.

After having been poured, tamped and finished in a horizontal position the first wall was raised into position some time ago, and the building is now completed.

The saving in time and labor by constructing a building in this novel form is great, as the material has to be raised but a short distance from the ground, and no false work, as the wooden forms are called, into which the concrete is usually poured, is necessary.

The equipment consists of a series of specially constructed derricks, or, technically, jacks, for raising the completed wall into position, and a platform built of two inch lumber, which rests upon the jacks a few feet above the ground.

In starting the work, the platform is laid inside the proposed building and boards placed about the four sides to

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complete the form of the wall to be built. The window frames are placed on the platform, with cornices and window caps, previously cast, in their proper positions. The concrete mixture is then poured in to the depth of about two inches, following which one-fourth inch twisted steel rods are placed in both directions across the surface, about six inches apart, and more concrete poured on and tamped until the wall is four inches in thickness. Lastly, a facing of white cement is put on to give the wall a finish.

TWO BIG ARCHES. FREE OF CONCRETE MOULDING FRAME-WORK. FORMING PART OF WALNUT LANE BRIDGE.

In forty-eight hours after pouring, the first wall was raised into position by means of the jacks underneath the platform, and so accurately was the apparatus placed, that the wall swung into a vertical position on its foundation without the least difficulty. It was held in place temporarily by props and the platform removed and set in position for the next wall. And thus the work was continued.

After all the walls had been erected in this way, the rods, which had been allowed to protrude at the edges of the different sections, were twisted together at the corners and concrete poured in to fill the space and make a neat joint. Thus all the walls were bound firmly together.

The columns and girders, made from the same material, were next erected and the floor laid on these.

A novel method was adopted in the construction of the floor, it being made of blocks of concrete two and one-half inches thick. These blocks were cast on the ground by first constructing a form with four rectangular pieces of board on a bed of sand. The blocks were reinforced with one-fourth inch iron rods, which were allowed to protrude at the sides a short distance. As each block was

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cast it was covered with a sheet of heavy paper, and after ten minutes another block was cast on top of it. By starting several piles at once, no time was lost in waiting for the blocks to become hard enough so that others could be moulded on top of them.

After laying the floor of the building with these blocks, the protruding rods were joined and the spaces between the blocks filled with rich concrete mortar, so that a perfect bond was formed throughout the entire floor. The floor then received a finishing coat of concrete on top, bringing the thickness up to the desired six inches.

One of the photographs of concrete construction reproduced herewith shows an interesting pair of chimneys, standing side by side, the one at the right being of ordinary brick construction while that at the left is built of concrete on the cold twisted steel system.

The new chimney of concrete measures 175 feet in height. The flue is ninety inches in diameter and the chimney is eleven feet eight inches in diameter at the base.

Fence of Concrete

WHEN machines for the manufacture of expanded metal were first perfected, their inventor had in mind the use of this material as a substitute for lath in houses, buildings, netting for warships, fence material, etc. That there would arise such a demand for it within the next few years, as a reinforcement for concrete, and cement work, was not taken into consideration at all, yet in these days hardly any piece of concrete work is attempted without its use in one form or another, and new uses are being found for it every day.

The accompanying illustrations tell a story for themselves, of a novel yet exceedingly satisfactory method of fence building. The metal posts were set in concrete in the usual way, the expanded metal stretched between them and the concrete plastering laid on very much as it would be applied to the walls of a house.

CLOSING UP THE END OF BUILDING CONSTRUCTED OF SEPARATELY MOULDED WALLS.

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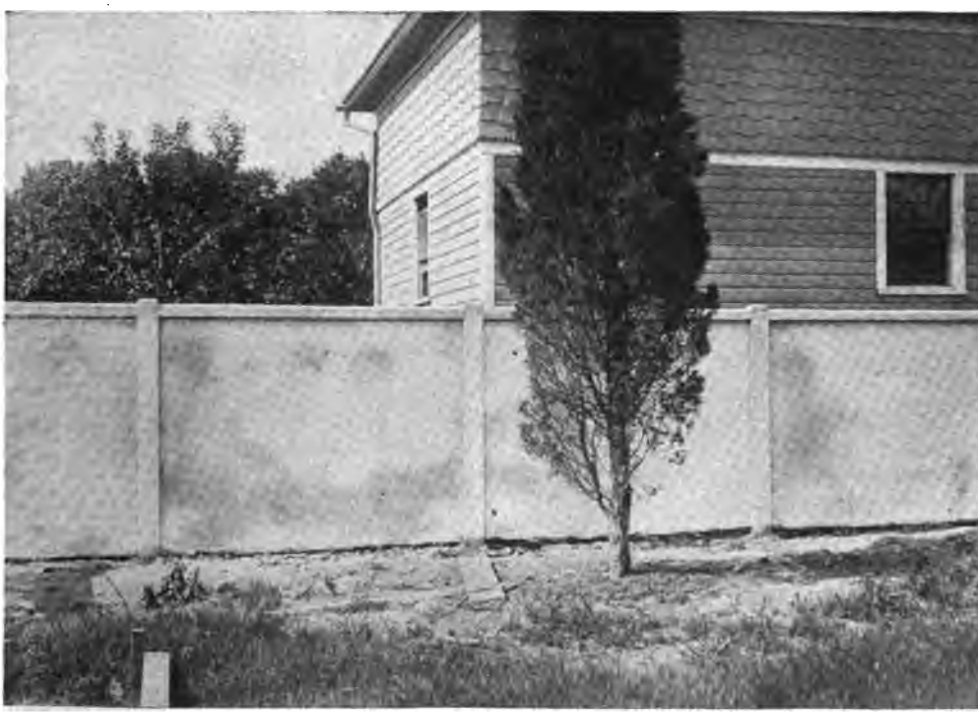
BUILDING A CONCRETE FENCE.

After the first coating had been applied to both sides and had set, a finishing coat was put on and smoothed up.

For all ordinary uses this fence is in every way as satisfactory as a brick or stone wall, while the expense of construction is considerably less. It is unaffected by heat or cold, rain or snow. There are no wooden posts to rot away and no painting is required.



THE COMPLETED FENCE OF CONCRETE.

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The appearance of such a fence is far superior to the ordinary brick or stone fence, and its cheapness, durability, and the fact that it never requires painting should recommend it highly for general use.

Monoliths to Carry Wires

THE problem of providing poles whereon to hang telegraph, telephone, and electric wires, as well as trolley wires, has been growing more and more serious for several years past, and, though there is some discussion on the subject, concrete poles would seem to be gaining steadily in favor.

Wood poles, which until recently were used exclusively, have become scarce and costly—very inferior wood poles now bring large prices. Also, wood poles must be placed close together, as their strength is not sufficient to carry heavy wires unless short spans are adopted. In consequence of the shorter spans, it naturally follows that a larger number of

How Concrete Poles Are Placed in Position in Sections.

An Enormous Stack of Reinforced Concrete.

Google

cross arms and insulators must be used, which in line equipment amounts to a very heavy item. It is also a weak point in the line, since insulator breakage is often large.

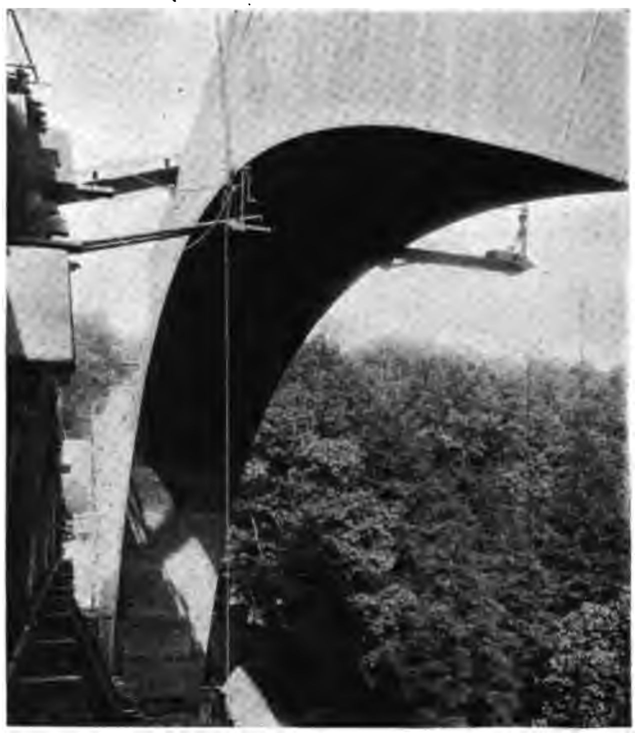
When it is desired to increase the span length, some stronger material than wood must be used, and recourse has been had to steel, but steel poles require a very heavy initial outlay, and a considerable sum must be devoted to maintenance.

Keeping in mind the disadvantages of the wood pole, and striving to improve upon the qualities of steel, inventors have designed the concrete pole. After several years of exhaustive tests and trials, it has proved, in various capacities, eminently satisfactory.

In the matter of design, the concrete pole is built to conform to the general idea of poles. In all lines there is a strain applied on the support that is greatest at the ground line, and decreases toward the top where the strain is applied. With this decreasing strain, it is of course apparent that a smaller section is required toward the top than would be necessary if the strain continued the same from the ground up, and to meet this condition, use is made of tapering reinforcing. As tapering steel is difficult to obtain, and as it is, moreover, costly, the tapering effect is attained by welding together rods of decreasing size, each size being in stock lengths. The work when done resembles a drawn-out telescope. The ratio between the area of steel and concrete is kept constant throughout, so that, while no unnecessary steel or concrete is used, all requirements as to strength are met.

The size of the reinforcing rods and the sectional area of the pole is determined when the height of the pole above the ground line is known and the horizontal strain ascertained by estimating the cable weight, probable ice coating, wind pressure, and the weight of birds resting on the wires.

The section of the pole is that of a square with the corners chamfered off, and has a regular taper from the bottom to the top. The reinforcing rods, four in number, are placed one in each corner. While these rods are placed as near as possible to the exterior, they are covered with sufficient concrete to protect them from the action of the elements.



THE FIRST OF THE CENTRAL SPANS IN THE WALNUT LANE BRIDGE IN PHILADELPHIA.

Contrary to the general impression, the concrete pole is not absolutely rigid, but is elastic within a broad enough limit to enable it to withstand all ordinary shocks. Concrete cross-arms are in use on several lines, and are giving every satisfaction.

A process for making thin-walled hollow concrete poles has been invented by Mr. Hans Siegwart, of Lucerne, Switzerland. These are coming rapidly into use, both in Switzerland with its numerous power transmission plants and in

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other European countries. They outwardly slightly resemble thin, tapering obelisks. In their interior they comprise a number of longitudinal rods kept together by spirally-wound metal wires.

As those poles are manufactured in large numbers, a special machine had to be designed for producing them most rapidly and economically.

Nineteen thousand cubic yards of concrete weighing more than 40,000 tons were used in the construction of the Walnut Lane, Philadelphia, bridge, recently thrown open to traffic and containing the largest unreinforced concrete span in the world. This structure was built by the city to afford a closer means of communication between Roxborough and Germantown, with a joint population in excess of 100,000. For years the two sections were as far apart, almost, as though miles of territory lay between them, but now the road for heavy carting has been shortened five miles and the carriage road two miles.

From end to end, stretching above Wissahickon Creek in Fairmount Park, the bridge is 525 feet long. The general plan of the structure is that of twin supporting arch ribs floored across on top and this scheme is carried out in the five approach arches and in the main arch, which last is of majestic proportions, having a 233-foot clear span between the piers. This plan insures economy as well as lightness. Over each main arch rib the floor is carried on eight pairs of spandrel or relieving arches, which support the four longitudinal walls upon which the floor rests. The whole is hollow underneath up to the floor, and consequently no

World's Highest Monolith.

earth filling was required. This, naturally, effected a great saving in weight.

There are five approach spans, which, while small in comparison with the main arch, are of a size that not many years ago would have been considered large. Each of these approaches is fifty-three feet clear between the piers and those next to the main span are about seventy feet clear above the ground. The whole structure is of concrete with a surface finish resembling stone in color, texture and wearing qualities. All the steel that was used—and the amount was small—is deeply embedded in the concrete, no metal is anywhere exposed to view or the elements and in all construction essentials there is an entire absence of reinforcement.

By all means the most interesting phase of the building of this bridge was the erection of the arches on a false-work centering. This was first erected under one of the parallel arch rings and, after that ring had been completed, moved over in its entirety to its position under the other ring. There were six stories of timber in the centering which rested on one layer of structural steel, and this, in turn, was on concrete piers founded on the Wissahickon Creek bottom. In dimensions, the falsework was 147 feet high, 232 feet long and 50 feet wide at the bottom. It had a total weight slightly in excess of 900 tons. On the top of the piers was a plate of cast steel, in reality a track, upon which were set cast steel rollers which bore the weight of the centering. To move the middle "bents," where the heaviest loads were, fifteen ball bearing ratchet jacks were used, each being of

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thirty-five tons capacity; for the outside "bents" there were nine jacks of fifteen tons capacity. Acting simultaneously on signals, thirty men in three working days moved the centering a distance of thirty-four feet. At each foot of progress correct alignments were preserved and at no time was the falsework out of alignment more than one inch. When the centering had been moved from the first of the parallel main arches no cracks were found in the big span.

WALNUT LANE BRIDGE, PHILADELPHIA.
This is the largest unreinforced concrete arch in the world.

More than 360,000 feet of timber, 130 tons of structural steel, twenty tons of three-quarter inch bolts and two tons of washers for the bolts were used in the framework alone.

The total cost of the bridge, which has a forty-foot driveway with eight-foot

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IRON-CONCRETE BOATS BUILT FOR THE ITALIAN NAVY.

sidewalks on either side, is $259,000, which is but $6,000 in excess of the estimated cost when the plans were laid down two years ago. While this cost is much in excess of what it would have been for a similar structure of steel the difference in initial cost is virtually equalized by the fact that there will be almost no maintenance expense, while a steel bridge must frequently be painted and kept in repair.

For two years more than 300 men were furnished employment in building the bridge under the direct supervision of the city's Department of Public Works. The plans were drawn under the direction of George S. Webster, the chief engineer, and Henry H. Quimby, assistant engineer, who personally superintended the construction details.

Recently Sir Maurice Fitzmaurice, the chief engineer of London, inspected it, and declared that it was worth the trip across the ocean to see it. It has attracted the attention of

THE COMPLETED WALNUT LANE BRIDGE RISES IN A HIGH WHITE ARCH AMONG ITS SETTING OF TREES.

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engineers throughout the world, and may be regarded as a model not only of engineering skill and care in designing and constructing but as a really remarkable triumph of architectural beauty as well.

Boats Built of Concrete

An Italian engineer, Signor Gabellini, of Rome, has advocated for many years the use of iron concrete for the building of ships and all kinds of floating structures. After being applied successfully in a great number of cases, his system has recently been officially sanctioned by the Italian government, which has decided to adopt it for its navy.

As concrete on coming in contact with water is known to acquire increased strength, this material would seem to be especially adapted for the building of boats. It also permits the additional advantage of a permanently smooth surface and correspondingly reduced skin-friction. The cost of maintaining such structures would be practically nothing and their life unlimited.

After the iron skeleton has been mounted, it is shaped according to the pattern, and then is covered with metal mesh. Concrete is finally applied until the desired thickness is obtained, and after the setting of the concrete, the structure is launched in order to be completed on the water.

The launching of these boats is specially interesting. Instead of being built like other floating structures on slanting slips at the water's edge, they are constructed in ordinary floating docks, which are likewise of iron concrete. As soon as everything is ready for launching, the pontoons at one end of the dock are immersed, thus obtaining the required slope.

Though iron concrete is three times as heavy as wood, by the new process it yields vessels and pontoons of the same floating power, while in the case of high tonnages, it allows the same lightness to be secured as with iron structures, without any diminution in resistance and elasticity. Owing to its iron reinforcement, the concrete mass does not break in the event of a sudden shock. It is true that if the load exceeds the limit of elasticity, a breakage does occur, but so slowly as to leave ample time for the detection and repair of the damage.

The first boat ordered for the Italian navy was constructed in 1906. The naval authorities had stipulated particu-

THE OVER-LOADED AND UNSIGHTLY WOODEN POLE.

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larly exacting tests for demonstrating the efficiency of the system. The fore part of the concrete boat though struck in full by the prow of a larger cruiser, was in spite of the violence of the shock, not damaged. Owing to these excellent results, the navy then ordered four similar boats, which have been recently completed.

These boats show a number of improvements, having double walls and water-tight compartments. Their capacity is about one hundred tons each and their draught when empty, is not much greater than that of wooden boats of a similar capacity. The first cost of these iron-concrete boats then is always less than that of iron vessels of equal tonnage.

As the same system is applied with equal success to floating structures of any shape and dimensions, it has been recently used for the construction of caissons employed in connection with the improving of the new Tiber harbor.

THE MEN WHO PREPARED THE PLANS FOR THE WALNUT LANE BRIDGE.
Geo. S. Webster, Chief Engineer, and Henry H. Quimby, Assistant Engineer.

CONCRETE POLES IN USE IN CONNECTION WITH THE ALBULA POWER TRANSMISSION PLANT, SWITZERLAND.

Another application of the same system is for the construction of floating docks to be used for the repairing of medium-sized ships, which, though too big for being hauled up the shore, are too small to be economically repaired in ordinary docks.

Another possible use of the system is in the manufacture of armor plates, made up of superposed layers of iron reinforcements with intermediary strata of concrete. The reinforcing iron rods are arranged in each layer at right angles to one another, so as to insure a maximum resistance and strength, and the whole system constitutes a perfectly homogeneous plate that perhaps may eventually be used as protection to war vessels.

Tests made by the inventor have shown the possibility of attaining with these iron-concrete armor plates a resistance to the impact of projectiles, equivalent to that of any given steel plate while insuring a saving of metal as high as thirty-three to fifty per cent.

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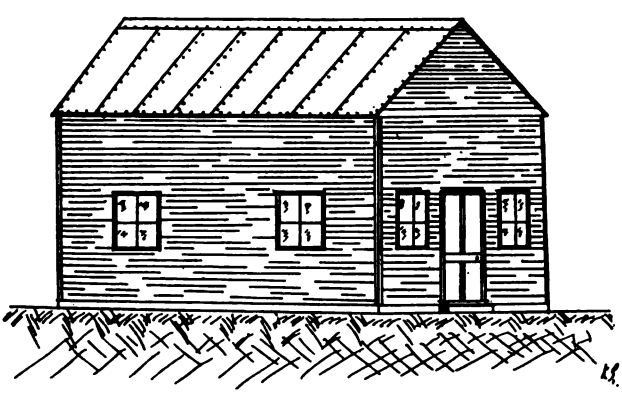
BUILDING NEW HOMES FOR ITALY

By SANDS CRAIGHILL

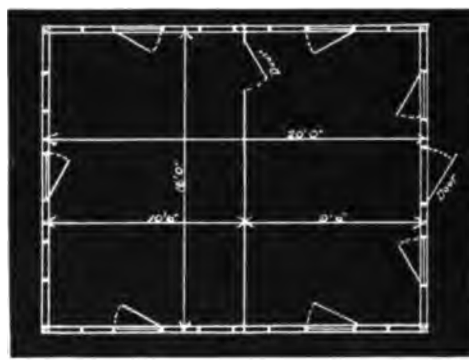
UNCLE SAM has undertaken at the request of the Italian Government the Herculean task of building within a very short time 2,500 cottages to shelter the homeless in the stricken zone in far-off Italy.

When that harrowing news was flashed over the wires telling of the suffering of the starving and homeless of our brethren in Southern Italy, Uncle Sam was the first to thrust his hand into his pocket and extend substantial succor. Eight hundred thousand dollars was what he gave as first aid to the injured. A great portion of this large sum is being used to feed the hungry, but $500,000 of it is to go towards the building of homes for the homeless. This work is being carried on with the utmost dispatch, for Uncle Sam is right on the job; he is the architect, builder and boss carpenter all in one. Ship after ship is being loaded with lumber and forces and hurried on this philanthropic mission, and soon a thousand homes built of American pine will shelter the people of another clime.



Sketch of Completed House to Be Erected in the Earthquake Zone in Italy by the United States.

The plans for the construction of these cottages were quickly arranged and hundreds of sets are being sent along with each cargo of supplies, with the specifications and instructions printed both in English and Italian, as it is proposed to



Ground Plan of Cottage for Italians.

have Italian workmen assist in the building.

The cottages are to be of the two-room type with ample windows and doors, and in their construction there will be but six sizes of lumber used, viz., the rafters, the studding, the caps, and the corner posts will be two by four inch pieces, the corner posts consisting of two such pieces nailed together. The sills are to be of two by six inch and the floor beams of two by ten inch material laid with twelve inch centers. The siding is six inch bevel, laid four inches to the weather, and the floors are to be of ordinary pine boards one inch thick planed on one side.

As the plans show, the windows are to be single sash, opening inward, with two side

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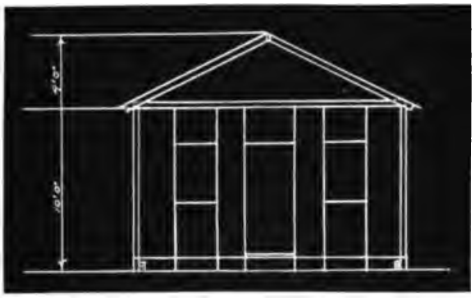
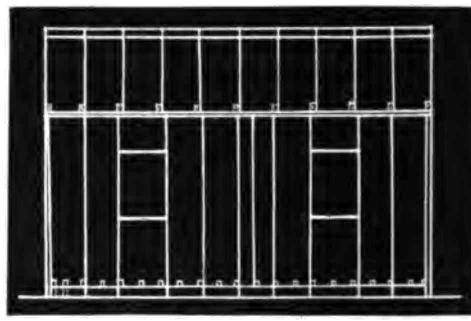


THE COTTAGE IN END ELEVATION.

hinges, and closing with a cupboard catch. Seven of these single sashes are provided for each cottage. Sufficient glass accompanies each sash cut to the required dimensions. The glass is to be secured in the sash by means of a strip beading and brads. Framing for the windows and doors is being supplied in the required lengths for putting in, in order to save all possible time in the construction of these houses; and hinges and locks are being fitted to each door so that they will be ready to hang as soon as the frame work is in position. The roof of each cottage is to be covered with a single layer of a patent roofing sent out in rolls. Such roofing may be secured by wooden strips or battens, or by cement and roofing nails; supplies of both go forth with each cargo. All the nails required of the proper size and carpenters' tools sufficient to supply workmen enough to begin the construction of fifty houses at one time, with two men employed on each structure, go out on every steamer. To erect such houses three days is ample for two good workmen.

The Superintendent of Carpenters and his assistants, sent out by the United States Navy, under whose auspices the work is to be done, on the steamers with the supplies, will have general supervision of the building operations, and their instructions in regard to selection of material and placing of it must be rigidly obeyed by all concerned in the work. Immediately upon the arrival of the steamers at the place where the buildings are to be erected, a model cottage will



PLAN OF COTTAGE IN SIDE ELEVATION.

be built personally by the United States carpenters as an example of how the work should be done.

To construct these houses, which are to be sixteen feet wide by twenty feet long, 7,500,000 feet of lumber is required. Some idea may be had of this enormous amount of timber when it is considered that it would require just about one thousand railway flat cars to haul it. Each cottage is to be built at a total cost of $150, whereas a portable house of similar size would cost $300, a saving by Uncle Sam of fifty per cent.

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PEEKING INTO THE LUNGS AND STOMACH

By CHARLES FLOYD BURROWS, M. D.

THE surgeon's ambitious dream of looking directly down the windpipe into the lungs or through the esophagus into the stomach for the purpose of diagnosing and treating diseases or removing foreign bodies is an old one; but recently it has indeed come true. Today experienced throat surgeons are accomplishing this seemingly impossible feat by using newly perfected instrumental appliances and are able therewith to discover obscure ailments or remove deeply hidden foreign bodies that otherwise on account of being beyond usual reach would cause untold suffering—probably death.

From old Dr. Hippocrates' time—yea even before that from the babyhood of Adam's infants—up to the year of grace 1909 children and grownups too have accidentally aspirated into the deeper respiratory air passages or carelessly swallowed into the gullet and stomach foreign bodies of all kinds. The list of such objects includes pins, needles, coins, pebbles, beans, nuts, bones, marbles, teeth, buttons, screws, nails, tacks, tin whistles, fruit pits, and glass, besides many other things. Some of these articles have been expelled at once by vomiting or coughing; some by dangling children head downwards, briskly thumping the back meanwhile; and some have been extracted tediously and painfully with old fashioned instruments. Others, alas, have been caught in the tissues beyond reach; have caused interruption of the function of various organs, severe inflammatory irritation and, sometimes, even death. A few have remained quiescently buried away for years, maybe almost forgotten, eventually either to be expelled, absorbed or to become trouble makers.

When caught in the esophageal food channel leading from the throat to the stomach the old custom has been to bunglingly attempt removal of these aliens by forceps or to try to force them by means of blunt instruments called "probangs" onward into the latter organ where they could be more readily removed by an operation or from which they could find their way outward easily via the intestines and rectum.

A TIN WHISTLE IN THE WIND-PIPE, WHICH WAS SUBSEQUENTLY REMOVED BY MEANS OF THE BRONCHOSCOPE.

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When, instead, alien articles have passed downwards through the larynx—or "speaking box," as it is popularly called—deep into the tracheal breath tube—the air passage from the throat to the lungs—or even beyond this pervading these obscure physical passage ways.

A sad case in point came to my personal attention a few years ago. A young woman under gas anaesthesia was having a tooth extracted. Just as the

COIN EMBEDDED IN WALL OF THE ESOPHAGUS. REMOVED BY AID OF ESOPHAGOSCOPE.

haps into one of its bronchial divisions and subdivisions, extraction of them always has been a serious, difficult, often hopeless task. Many a person has died from the results of such sad accidents whose life would have been saved easily now by the modern instrumental means —described a little farther on—for in-

tooth was pulled it accidentally slipped from the forceps, fell on the back part of her tongue, rolled toward the throat and instantly disappeared before it could be rescued, sucked by a deep inspiration under the stimulus of returning consciousness, deep into her lung. Despite every effort then known to locate and

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remove it nothing was accomplished. Not being a strong woman she soon weakened, grew sick and died a few months later from pulmonary tuberculosis. An autopsy revealed the offending molar almost completely plugging the

SIDE VIEW TAKEN IN ORDER THAT THE SURGEONS MIGHT DIFFERENTIATE THE COIN IN THE OTHER PICTURE FROM A POSSIBLE GLOBULAR BODY. AS A MARBLE.

second division of the right bronchial tube, cutting off normal aeration of the lung beyond this point, thus inducing consumption and death. Nowadays it would be a "cinch"—if I may be allowed this apt slang expression—to remove such an object and save a life.

But besides the unintentional entrance of disturbing material into the lungs and stomach and the tubular channels leading to them, many hitherto hidden diseases of gastric or respiratory origin arise frequently to annoy, alarm and distress various people, puzzling us doctors by their secretiveness and so baffling remedial treatment. Tumor formations, enlarged glands in small children, aneurisms—i. e., diseased, dilated blood vessels—and abscesses hidden away within the ribbed chest, often compress slowly and torturingly, with a grip more deadly than a bull-dog's, the vital pipes leading

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downwards from the throat. Such pathological conditions are now possible of optical detection where formerly they could only be guessed at—much less scientifically treated. Stomach ulcers, cancers and constrictions are brought immediately into range of an examining surgeon's eye, allowing, if need be, topical applications of drugs or curative operations to be directly performed thereon—many cures otherwise impossible thus being effected. Even the lower opening of the stomach into the bowel has been passed and the upper two or three inches of the duodenum—or small gut—brought to light. More awesome, this peering into the secret realms of physical life, than opening the long closed mausoleums of Egypt's dead!

"How has this ability to peer half way down through the living body been made possible?" and "By what technical means is it made applicable practically?" In answering these questions a little historical knowledge is necessary.

A hundred years or more ago a man named Bozini primarily succeeded in examining the upper end of the esophagus. From his time onward until 1856, when Garcia invented the laryngoscope, not much advance was made in looking below the throat. The discovery of this instrument, however, was a big stride in the right direction, though unfortunately its field of usefulness is somewhat circumscribed. Briefly described, a laryngoscope is a small, round mirror considerably like the little looking glass a dentist uses when filling teeth, varying in size from a dime to a quarter, held at an angle on one extremity of a stem sufficiently long to reach the back part of the throat through a wide open mouth. By reflected light thrown on its surface from a head mirror worn by an examiner a view of the interior of one's "talking machine" with its wonderful vocal cords stretching across it like a pair of violin strings, can be easily obtained. In fact, one who is trained in using this simple device can look through anybody's "graphophone," even into the upper part of the windpipe—though one can see distinctly only for a little way. Nevertheless this laryngoscopic mirror has been a boon to suffering throat patients and has allowed much helpful therapeutic and operative work to be done by doctors where before its invention it was quite impossible. Even so its field has been comparatively small and ambitious physicians have sighed longingly for better means wherewith to explore the mysterious territory just beyond their reach. It was not until 1897 that much progress was

SURGICAL INSTRUMENTS EMPLOYED IN REMOVING FOREIGN SUBSTANCES FROM THE HUMAN BODY.

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made in invading this region darker and more perilous to investigate than Arctic zones at night. Then an adventurous explorer named Kirstein described a method whereby electric light could be thrown directly down into the larynx, trachea or esophagus through hollow tubes inserted in their orifices. This led the way for other medical Pearys until ten years later in 1907 an American, Chevalier Jackson, perfecting and combining Kirstein's with other men's devices, evolved the *bronchoscope,* the *esophagoscope* and the *gastroscope,* as these instruments are technically called, and fashioned besides many accessory tools to further their scope of utility. These utensils have made possible what is known today as *bronchoscopy, esophagoscopy* and *gastroscopy,* or in plain English, visual examination through electrically illuminated mechanical appliances, of the lungs, stomach and mucous pipes leading to them.

They are hollow cylindrical nickel tubes, varying in length from a foot to two feet, and in diameter from a quarter to a half inch. Some are perforated to allow, when inserted in the windpipe, the passage of air to the lungs; others carry an easily removable, blunt, rounded plug, at the distal, or lower end, to facilitate their entrance; and each is equipped with a small bull's-eye electric light bulb at the lower extremity, connected by delicate wiring to a dry cell battery or a wall plate, which when lit brilliantly illuminates the walls of mucous tissue for the expert observer's eye to study as the tubes are pushed slowly, skillfully onward by his dexterous hand. By means of delicate long handled hooks, applicators, forceps and curettes—i. e., hoe-like affairs—an ingenious surgeon—besides just "rubbering" down to discover disease—can do a lot of adept surgical work through them, comparatively small though they be; treat medicinally various pathological conditions; and remove foreign substances of all kinds.

Intricate as it may seem to the uninitiated the using of these instruments is not so difficult or dangerous as one might hastily imagine. Of course they are not playthings to be used carelessly by every one or to be swallowed to amuse the curious, like swords in a circus side show. Only skilled throat specialists or surgeons after careful practice on animals—anti-vivisectionists to the contrary notwithstanding—should attempt their use freely, though in emergencies they might probably be used successfully, if not so adroitly, by any nervy, resourceful physician.

WHAT THE BRONCHOSCOPE FOUND IN THE LUNGS AND RESPIRATORY TRACT OF ONE INDIVIDUAL.
A pin, a fish-bone, a cloth-covered button, a small pebble, and a lead tip from a child's toy.

The technique of their introduction through the mouth into the body is about as follows: A patient is anaesthetized with ether—though cocaine is used locally sometimes instead; the head is brought well over the edge of a table, the jaws held widely open by a mouth gag and a proper sized well greased tube is inserted gently, dexterously, in either the opening of the larynx, or the esophagus, as the case may be, and carefully pushed downwards. As the instrument becomes inserted, the plug is pulled out and the electric light switched on. So under the observer's eye, the tissues ahead of its ingress spread out for inspection somewhat as the walls of a murky tunnel do when a locomotive's headlight moves through the darkness.

Up to the present time over 200 foreign articles have been removed by these means from the intricate recesses of the respiratory and stomachic tracts that probably never could have been rescued by any other safe method. Is not this alone a surprising record of suffering relieved and lives saved?

But besides this many peculiarly serious but obscure affections of the chest and pulmonary tissues have been diagnosticated early thus permitting a rational therapy; and anomalous distressing conditions have been discovered, often to be successfully relieved, that heretofore unfortunately have been mistaken for other disturbances until death mercifully has closed in an agonizing scene allowing at last, alas, on the post-mortem table a revelation of the true disorder.

As examples of what may be accomplished along such lines the following two instances are interesting as well as illustrative: In a recent issue of a reliable medical journal a boy is told of who from the age of six months had persistent difficulty in retaining his food. Sometimes it would stay down; more often be promptly vomited. This condition despite every effort put forth by various physicians consulted by his desperate parents prevailed until the lad was five years old. He was then weak, almost a skeleton, and the end seemed not far off—all the result of the slow starvation he, for some unaccountable reason, was undergoing. Finally an X-ray photograph of his chest was made. It showed that a small coin, which some one some time had thoughtlessly slipped into his baby hand had been swallowed baby-wise, and now was embedded in the back wall of the esophagus near its opening into the stomach. Efforts to remove it by forceps were unavailing as the coin evidently had become buried in the tissues. At last a surgeon, experienced in its use, passed an esophagoscope down the gullet and near its lower end discerned a queer swelling. Gently scraping it with a curette the edge of a penny was brought to view and the coin was then easily removed from its singular purse. The boy made an uneventful recovery, returning, in the course of time, to normal condition.

Another case was that of a woman fifty-six years of age who for several weeks had been suffering from peculiar suffocative "spells" which came on suddenly causing intense suffering and alarm, turning the skin bluish and often producing unconsciousness—*almost death.* Each attack seemed worse, more dangerous; and repeated examinations of all kinds—even X-ray photography—failed to reveal the cause, though tentative diagnosis of a tumor or abnormal growth of some obscure sort within the chest compressing the air channels seemed the only rational explanation. She was removed to a hospital where a bronchoscopic examination was made and it was discovered that the bronchial tubes as they branched off respectively to the right and left lung from the windpipe were narrowed almost to a slit by contracting bands of new fibrous tissue the result of ulcerations in the mucous lining. These strictures were promptly dilated by successive operations through the bronchoscope and topical healing applications made to the small ulcers surrounding the constrictions until finally *a perfect cure resulted.* Now practically all this was accomplished safely inside a living palpitating chest eighteen inches below the mouth, full of delicate complex glands, veins, and arteries, more intricately associated than the complicated mechanism of a watch, under unconsciousness to pain produced by that wonderful anaesthetic, ether, *without spilling a drop of blood.* Surely Æsculapius never dreamed of such a phenomenal procedure—much less witnessed it—even in the Olympian days!

Recently a throat specialist of repute, who already has become quite proficient in the use of these instruments, enthusiastically declared to me: "We are on the threshold of a new era in diagnosing and treating disorders of the lungs and stomach. We shall soon be able successfully to delve further into these deep seated organs and search out disease sooner even than has been done in the genito-urinary tract with the cystoscope and by catheterization of the kidneys. In conjunction with the X-ray we shall locate exactly and remove all foreign

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bodies from the pulmonary and the stomachic tissues; by direct applications of medicaments, cure ulcers of the stomach; retard or early remove cancerous growths of that organ; and dilate the deadly strictures which so often narrow its pyloric opening into the bowels. In the lungs we shall discover and open abscesses, relieve constrictions of the air passages and apply drugs curatively to tuberculous ulcerations. Perhaps—if the theory be correct that light is antagonistic and deadly to the germs of tuberculosis—we may materially decrease the death rate of the white plague by pulmonary illumination in the early stages of consumption. In all of these conditions and in many others which time and study will reveal, we shall, through the use of these tools bring some of the innermost parts of our bodies within the reach of helpful skill, thereby relieving much misery and saving innumerable lives, thus helping considerably to bring nearer the medical millennium when all people shall die from old age only."

And undoubtedly he was right; for the miracles wrought by latter day medicine and surgery are fast rivaling those of Biblical times.

To Thomas Moore

Here's a sigh to those who love me,
And a smile to those who hate;
And whatever sky's above me,
Here's a heart for every fate.

* * * * * *

Were 't the last drop in the well,
As I gasped upon the brink,
Ere my fainting spirit fell
'Tis to thee that I would drink.

—BYRON.

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MOVING PICTURES IN COLORS

By CECIL BEMBRIDGE

THE magic lantern of our childhood days, the manipulation of which in the youthful mind was regarded with feelings of mystery as to how photographs could possibly be projected on a large white sheet with such clearness of minute detail, has become numbered among the things that were. Portrayal of still life has given place to that in which every motion is faithfully rendered by the kinematograph. Little did the inventor anticipate such unique popularity, when, in 1885 he showed a simple apparatus by the turning of the handle of which he depicted on the screen incidents of every day life in the fullest detail. It was as if he had harnessed the camera obscura, packed it in a box, and compelled rendition when he so desired by the mere turning of the unpretentious handle. Little wonder therefore that the members of the Royal Photographic Society of London before whom the discovery was first shown, regarded it with amazement.

Yet its possibilities were far from realized. The inventor himself regarded it rather as a scientific toy in much the same light as the gyroscope has been considered, so he packed it away and practically forgot its existence. To him it possessed no commercial possibilities. At that time he was not far wrong in his conclusions. The celluloid photographic film in long lengths had not then been invented. His photographs had to be made on revolving glass disks, obviously a very difficult and inconvenient process, requiring care in handling to prevent breakage, while at the same time they were bulky and heavy. Two years later he pressed his scientific toy into service as a novelty for advertisement purposes. He set it up in his window in Piccadilly and revolved the plates projecting the pictures on a small screen for the benefit of one and all that might be passing, never dreaming of what would follow. It proved the most magic force in advertising that has ever been devised. The fashionable street of the West End of London became packed with sightseers struggling to catch glimpses of these pictures in all the animation of real life. The traffic was dislocated and the police, apprehensive of public safety requested the owner to withdraw the novelty from his window. He acquiesced and for the second time the scientific toy was packed away.

PICTURE TAKEN ON A SINGLE FILM. EACH HALF OF WHICH WAS TAKEN THROUGH A SEPARATE COLOR FILTER.

In 1889 it was once more brought out of its resting place for since the last demonstration to the public in the street of Piccadilly the inventor had been thinking hard. He was seeking for a flexible substitute upon which his photographs could be recorded. He had struggled with gelatin and other obvious substances of a like nature with commendable zeal but indifferent success. At last he bethought him of celluloid in long lengths. By dint of perseverance and resort to many ingenious artifices he succeeded in making thin sheets of this material which he cut into a series of narrow strips and joined together, sensitized, and secured a series of photographs taken at about thirty per second. He prepared similar celluloid transparencies from these negatives and exhibited the sum of his efforts at the Crystal Palace in 1889, in which year the first patent was granted to Mr. William Friese-Greene, F. R. A. S., F. R. M. S., and associated with a host of other of the scientific institutions of Great Britain for taking photographs on films in such a manner that when projected on the screen a life-like action was produced.

Such in brief is the story of the discovery of cinematography—an invention full of romance evolved by its inventor in the pursuit of his scientific investigations to demonstrate a certain phase in photographic science but now one of the most valuable commercial assets in the world. Mr. William Friese-Greene is the father of Cinematography, and the story of the difficulties with which he had to grapple, as great in their character as those experienced by Daguerre in obtaining his sun pictures, teems with absorbing interest.

The inventor has never forsaken the field of research associated with his discovery though the fruits of its commercial development passed out of his hands. No sooner was it launched upon the sea of success by other exploiters in the same field whose attention had been drawn to the subject by the commotion created in Piccadilly, and the extent to which the public curiosity was thereby aroused, than he set to work upon the solution of two other problems in connection with the art and which have completely baffled other investigators. It is a story of twenty years' patient research and endless experiment, but which he has now finally overcome in a manner so simple as to appear impossible. This is the taking and projecting of cinematographic pictures in natural colors and their reproduction upon the screen in the full beauty of Nature. But not only in colors. The pictures are shown stereoscopically as well.

It was in one of the laboratories on the south coast of England that the mystery of this latest development was unravelled to the writer. At the time of my visit Mr. Friese-Greene was busily engaged in completing his arrangements for the demonstration of his apparatus

WILLIAM FRIESE-GREENE. INVENTOR OF THE MOVING COLORED PICTURE MACHINE.

before one of the learned societies of London. The special films upon which the photographs have to be taken were in process of preparation, while some two dozen that had already been completed were being run through the small projector he has devised for such work to receive his approbation.

As the discovery was to make its bow to the public via a gathering of scientists it was essential that absolute perfection should prevail. The camera itself, which outwardly is of the same size and appearance as the ordinary black and white cinematographic machine, distinguished only externally by its twin lenses, was busy at work upon the most difficult subjects it is possible to attempt in chrono-cinematography.

The inventor in this study has proceeded upon quite original lines. Other investigators in the field of color photog-

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FRONT OF THE CAMERA, SHOWING THE TWIN LENSES.

raphy have published data concerning their ways and means of achieving their ultima thule but they are totally different in those of this worker. For several years Mr. Friese-Greene was engaged in delicate work with the spectrum in connection with astronomical research, and the experience he thus gained respecting colors and their peculiar phenomena have been of material assistance in his latest enterprise.

"Just look at this," he remarked, at the same time handing me a large spool of film. "It represents one of the most difficult subjects I have yet taken. It shows practically a plant from the time the first shoot appears above the soil until it is in the full panoply of gorgeous bloom." Held to the light it resembled merely an ordinary black and white transparency or positive. Closer examination revealed the fact that every picture slightly differed from its neighbor. At one point it was somewhat more opaque—at another more transparent. But still more critical examination showed that the pictures were really resolved into groups of threes, so far as intensity of image was concerned but otherwise different so that they became consecutive. Full analysis of the film indicated that the first picture of each group of three had another relationship, the second and third respectively were the same. The first were those which had been photographed through the red screen, the second those taken through the green screen, and the third under the violet screen, since these three colors are the fundamental colors of the spectrum from which, as is well known, all other colors are built up. Consequently, although when the transparency is projected upon the screen in black and white, it appears as an ordinary picture; when the respective color screens are inserted so that the black image taken through the red color filter is thrown once more through its corresponding color screen and the others likewise the image on the screen falls into line with the peculiarity of visual persistence and one actually sees a perfect three color picture.

It must be understood, however, that three pictures are not taken respectively through three screens. In other words an image is not photographed through the red, then through the green and finally through the violet, and the three pictures then thrown on to the screen in superimposition to produce the three-

INTERIOR OF ONE SIDE OF CAMERA.
The operating mechanism with reference to the sensitized film and the color filter band.

color effect. Such a procedure would entail the film being three times the length of that required in ordinary black and white work, while subsequent projection would necessitate the use of three lanterns throwing respectively the red, green and violet pictures at three times the normal speed. The film is of the same length as would be required for ordinary monochrome work while only a twin single lantern is used.

At first sight it appears absolutely impossible to achieve such a result by this means, but in reality it is very simply accomplished by means of the Friese-Greene method without resort to intricate apparatus or complicated working. In order to understand the whole operation it is first necessary to explain the design and manipulation of the camera and projector.

Although the camera is fitted with two lenses and works stereoscopically it does not do so in the generally accepted photographic sense of the word. In ordinary photographic work of this character the two exposures are made at the same moment, the record of the two lenses being just as the eye sees them. The stereoscope superimposes the two images, making only one. The two distinct pictures as seen by the eyes become blended together so that the brain only receives one impression. In the Friese-Greene camera, however, the exposure of the two lenses is alternate. This is done for two specific purposes. In the first place it must be borne in mind that when making a cinematograph negative the incidents depicted are in reality a series of snap shots. They are not moving in the true sense of the word, since there is some motion lost during the period the shutter is closed, but the pictures being taken in such rapid sequence the eye does not succeed in noticing the lapse between each exposure. This disadvantage cannot be avoided with the existing apparatus as the shutter must be closed during the small fraction of a second, which is required to bring a fresh unexposed part of the film before the lens.

THE INVENTOR OPERATING THE CAMERA.

In the Friese-Greene method by making the shutters work alternately, the one records the period of motion lost by its fellow lens while covered by the shutter. Consequently in reality two different films are secured of the one incident which if projected in black and white would equally depict the scene but in two ways, since the one would show what the other had failed to record. Then again the twin alternate lens motion is requisite to secure the desired blending of the colors whereby the resultant heliochromic image is seen on the sheet.

The camera is divided into two individual sections each self-contained and distinct from the other, though both are

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fitted with the same mechanism and exactly alike in every particular. The unexposed sensitized film is placed on its spool in the upper right hand box in the usual manner, issuing therefrom through a slot at the base. This film is then passed round a pulley up over a second pulley on to a drum. Here it picks up the color filter film which will be explained later. From this drum it is guided into a slot which leads it down the front of the camera to the lens aperture. Just above the latter point it is seized by the teeth of an oscillating arm which is made to rise and move forward and then descend, engaging in the last named movement with the perforations in the edge of the sensitized film and its color filter, jerking them forward three-quarters of an inch over the lens aperture, and holding both films tightly there during the period of exposure. When the shutter closes again the oscillating toothed arm rises, moves forward, and upward, and seizes a fresh length of film jerking it into position in the same way, the film thus being moved forward three-quarters of an inch immediately before each exposure. After being exposed the film passes over another drum where the color filter having completed its work leaves the sensitized film which passing over a third drum enters the lower or exposed film box and is wound on the spool in the usual manner.

The most vital part of the instrument, however, is the color filter. This comprises an endless band subdivided throughout its entire length successively into small colored areas, each of the dimensions of a cinematographic picture, of red, green, and violet, respectively. This filter is made of celluloid, this material having been selected as the thinnest possible for the purposes and in which refractive disturbances are quite eliminated. The color screen is brought into immediate juxtaposition with the sensitized surface of the photographic film and like that, being perforated along its two edges, is brought and held in dead register with the film throughout the whole operation. The color filter band and the photographic film diverge after the exposure has been made at the second drum, the color film passing over a third pulley, then proceeding right around the camera by means of three additional pulleys and a jockey pulley until it rejoins the unexposed film issuing from the upper spool box at the first drum. The utilization of the jockey pulleys serves to keep the endless color filter band in a perfectly tightly stretched condition, so that there is no possibility of the two being thrown out of register, and the whole of each picture secured must be obtained through one of the three color filters.

But the color filters in the two separate sections of the camera do not travel in harmony. That is to say the reds, greens and violets do not work in such a way that the same colors are successively shown. In other words pictures are not recorded on either side through two red screens, two greens and so on, nor does the red of the band for the second lens follow the red of the first lens. Instead the disposition of the two bands is such that when a red in the first lens is exposed it is followed by a violet in the second lens which in turn is followed by a green in the first lens, and again by a red in the second camera, and so on. Consultation of the diagram—page 296—will show how the two color film bands expose successively when working. It is this arrangement which constitutes the vital secret of the whole invention and the discovery of the system is a notable contribution to our knowledge of colors. What really takes place is what the inventor terms the cutting in and cutting out of the colors. The effect is practically the same as obtains when one uses the dissolver on the ordinary magic lantern, only instead of one picture being dissolved into the other the three fundamental colors, red, green, and violet, become dissolved or blended together, thereby producing the thousands of tints and hues between these three base colors and from which they are built up.

The camera works in the same manner as the ordinary single lens cinematographic instrument by means of the single handle, by which the whole of the various sections of the mechanism are set in motion to perform their individual tasks. The shutter is so designed that the period of exposure of each lens is precisely the same so that perfect balanc-

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A. FACE OF CAMERA WITH LENSES REMOVED, SHOWING SHUTTER ARRANGEMENT.
Lens with the blue filter is exposed, the other lens is shut.

ing of the images on either film is assured.

When it comes to the projection, obviously, in order to secure the desired stereoscopic impression true to nature in point of color, two lanterns must be used, one film for each. Similarly there must be two color filter bands working on the same endless system. Suitable devices are introduced to ensure that, upon the insertion of a new film picture, the sections which were photographed through a red color screen are projected through a red color screen, so that there shall be no confusion in the colors. The same disposition in regard to the two color films to secure the desired cutting in and cutting out of one color with another as practiced in the camera is repeated in projection, and it is this blending which ensures the conveyance of an absolutely truthful representation of an image in natural colors to the brain. The two lenses are fitted with finely devised adjusting screws so that the angle of one to the other may be altered at will according to the size of the picture, which in turn is influenced by the distance between the screen and the projector. By this means the illuminated spaces on the screen from each lantern become superimposed with absolute precision so that when set in motion there is no possibility of the two pictures becoming thrown out of register, such as is sometimes observable in color printing on paper or other fabrics. Although the pictures are taken at the normal rate, viz., 16 per second, which is about the limits of the receiving capacity of the human eye and brain, it must be remembered that the two cameras working together give a total of thirty-two pictures per second. This speed being repeated in projection—though the eye is deceived to the extent that it appears as if only sixteen pictures were being given per second—assists in the blending of the colors to present the characteristic impression of a three color image in accordance with the laws of visual persistence.

As may be realized, the preparation of the color filters in order to secure the pure absolute fundamental colors of red, green, and violet, called for tremendous research and patient experiment. Hundreds of filters were produced by the inventor before he finally succeeded in achieving the ultimate result. In this work, however, his knowledge of spectrum analysis stood him in valuable stead, but it may be pointed out that in this

B. SHOWING SECOND LENS EXPOSED WITH BLUE FILTER.
A and B show alternating motion of shutter and exposures.

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phase of the work he encountered many curious and unexpected results which have hitherto been unknown. Once the colors became standardized as it were, the work was comparatively easy and now the color filter bands can be prepared expeditiously and cheaply.

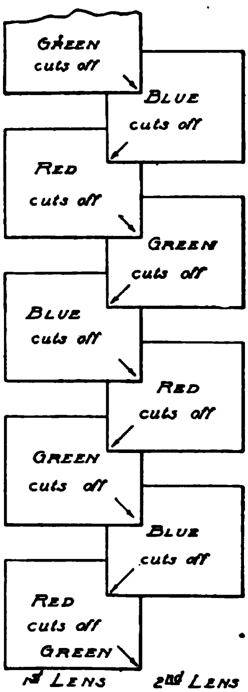

DIAGRAM SHOWING HOW THE COLOR SCHEME WORKS.

Another point of importance moreover, has been the great improvement of the sensitized films. These can now be made as rapid as required for any speed in photographing, or to fulfill any other peculiar conditions. The films have to be subjected to special treatment since that ordinarily employed is quite useless, because, as is well known, the colors of the three fundamental units of the filter band are of varying light resisting capacity. By the special treatment of the sensitized surface carried out on the lines Mr. Friese-Greene has evolved, the non-actinic properties of these colors are broken down somewhat, so that in the photographs the relative color densities are produced. In fact so sensitive are the films rendered that in the dark-room work has to be carried out in practical darkness, the lights instead of being of the conventional ruby type being shaded with superimposed red and green glasses. For the making of the positives, however, the ordinary films may be used.

At first sight it may be thought that cost of operation will render the process commercially impossible. This, however, is not the case since it is an outstanding characteristic of the Friese-Greene system that cost of preparing pictures in color is but little in excess of that for preparing monochrome pictures, and certainly cheaper than hand coloring of the films, which is but crude. True, owing to duplication of the camera photographing equipment, and the projector, the capital outlay in this direction is practically doubled, but even in this case the simplicity of the mechanism enables it to be manufactured at a reasonable figure. The color filter bands are inexpensive and with care have a long life. Moreover by his system of projection ignition of the film is rendered impossible except by sheer carelessness or wantonness. The cost of photographing in the colors averages from 50 to 75 cents per 100-foot run, but here again once the master negative is obtained transparencies can be multiplied indefinitely and at the same outlay as is incurred for preparing black and white films.

The general consensus of opinion among those interested in cinematography and those in scientific circles is that this stereo-chrono-cinematographic process is destined to supersede the existing process and will bring about as complete a revolution in cinematography as the animated picture apparatus exercised in regard to the antiquated magic lantern.

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E. H. HARRIMAN'S CAMP AT SAN ANTONIO, TEXAS.

REMEDY FOR "SKY-SCRAPERITIS"

By W. D. HORNADAY

E. H. HARRIMAN, whose greatness in the railway and financial world makes him a person of special interest to the masses of the people of this country, believes in living close to nature. In order that his run down physical being and tired mental faculties might be given a good rest and relaxation he established a winter camp at San Antonio, Texas, where he lived in a tent for several weeks. He recuperated rapidly under the benign influence of the warm sunshine, the pure ozone and the outdoor exercise which was a part of his daily program while living the simple life.

When Mr. Harriman first went into camp at San Antonio he explained that while he occasionally felt a twinge of rheumatism his real ailment was "sky-scraperitis." He had diagnosed his own case, he said; no physician had been called in to treat him and he sought nature's cure without seeking medical advice. According to Mr. Harriman, "sky-scraperitis" is not a defined disease; it is a restless and uncomfortable feeling that comes over a person who lives in cities away from the heart of nature. Sunshine, pure air, the rippling of running water, the songs of birds and the panorama of fields and groves of trees soon restore the patient to normal condition.

Had Mr. Harriman been so inclined during his stay in his winter camp at San Antonio he could have transacted his multitude of business affairs with almost the same dispatch as in his offices in New York. Close to his tent were private telegraph and telephone wires and instruments by means of which he was kept in constant close touch of the more

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important business affairs that demanded his attention. By force of necessity he transacted more or less business every day that he was in camp, but he managed to obtain several hours of recreation and rest each day. He threw off all business cares as far as it was possible to do so.

The life which Mr. Harriman led in camp was democratic in every respect. He was accessible to any and all visitors caller to walk right in. He talked freely and without reserve upon almost any topic that might be broached except those subjects which related too closely to his business affairs.

The Harriman camp consisted of four tents, each of which was plainly but comfortably furnished. Perhaps $200 at the outside would represent the cost of the furniture and fixtures of each tent. The program of exercise and recreation fol-

INTERIOR OF TENT IN WHICH E. H. HARRIMAN LIVED WHILE RECUPERATING FROM THE STRENUOUSNESS OF BUSINESS LIFE.

at certain times of the day when he was not busy with his correspondence or in conference with officials or representatives of his railroad or business interests. The camp grounds were unguarded by police or detectives. The presentation of a card was not even necessary in order to see the railway magnate. If Mr. Harriman was not busy he would invite the

lowed from day to day by Mr. Harriman varied greatly. He played a few games of golf, rode horseback on several pleasant mornings and indulged in automobile rides almost every day. His favorite exercise was walking. He took long pedestrian excursions along the banks of the San Antonio river and to points of interest in the vicinity of the camp.

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SHIP MADE WITHOUT IRON

By ROBERT FRANKLIN

SINDBAD the Sailor, it will be remembered, while pursuing one of his eventful voyages, met with shipwreck, owing to the circumstance that his vessel approached too near to a certain mountain of lodestone, much dreaded by mariners, which, exerting an irresistible magnetic power, pulled every nail and bolt out of the ship, causing her to fall to pieces.

Against the possibility of a misadventure of this kind, while sailing the seas, one modern ship, at all events, may be said to be adequately insured. She has been built, and is now being outfitted in Brooklyn by the Carnegie Institution—a brigantine-rigged yacht, measuring 155 feet, 6 inches in length over all, with a beam of 33 feet, and a mean draft of 12 feet, 7 inches. With all her stores and equipment on board, she will have a displacement of 568 tons.

The *Carnegie,* as she has been named, is a beautiful little vessel, and is provided with every luxury that can ordinarily be found on a millionaire's yacht. But the really remarkable point about her is that she has been constructed in all her parts almost without the use of iron or steel. Even her planks and beams are held together with wooden treenails and bolts and spikes of copper and bronze. Her engine and other machinery are of bronze and brass and the very propeller is of manganese bronze.

All of this has directly to do with the fact that the ship is built for the purpose of making a magnetic survey of the navigable waters of the world. It is a task which the Carnegie Institution has made peculiarly its own, and which it

THE *CARNEGIE*. A SHIP BUILT WITHOUT A SINGLE PIECE OF IRON.

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has already been carrying on for several years. Under its direction, the yacht *Galilee* has accomplished three voyages in the Pacific Ocean, winding in zigzag fashion among the archipelagoes, ranging from New Zealand to Sitka, Alaska, and covering a total distance of 60,000 nautical miles.

In the course of these voyages, the *Galilee* made the first reliable magnetic chart of the Pacific—previous scientific work in this line having been limited to occasional and more or less desultory observations at points along the west coast of America and on the shores of a few islands. With a view to future work, however, in the Atlantic Ocean and elsewhere, it was deemed desirable to build a vessel that should be perfectly adapted to the business in all respects—especially in the matter of structural materials, which, if of iron and steel, would be likely to interfere with the accuracy of magnetic observations on board.

Hence the building of the *Carnegie*, which is expected to start on her first voyage on or about the first day of this July. From New York she will go direct to Hudson Bay, and will make a series of magnetic observations along the route of a proposed line of steamers through Hudson Bay from Churchill to Liverpool, England. This line is to furnish transportation for the output of the vast wheat fields of the Canadian Northwest. When this has been accomplished, the ship, early in 1910, will undertake observations of compass variations along the main tracks of transatlantic navigation followed by the ocean greyhounds.

"TAKING SIGHTS" ON THE *GALILEE*, ON HER CRUISE IN THE PACIFIC OCEAN.
Inasmuch as iron was used in her construction, the magnetic survey did not find this vessel quite adequate for their purposes.

It is a matter of historical record that, when Christopher Columbus was voyaging across the Atlantic—blundering upon the shores of America on his way to the India he expected to find—a cause of much discontent among his sailors, almost giving rise to mutiny, was the fact that the compass needle did not point in its accustomed manner to the North Star. Knowing nothing about magnetic variation, they suspected the cause to be some hostile supernatural influence. At the present time, however, mariners are aware that such variations must be reckoned upon wherever they may go.

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For purposes of accurate reckoning, so necessary to safety on the seas, there ought to be reliable magnetic charts for all the waters of the world, showing the variations of the compass needle from true north in every latitude and longitude. But, unfortunately, such charts do not exist. Different nations have undertaken the work from time to time, but only in a very fragmentary and desultory way. Hence the great importance of the enterprise taken in hand by the Carnegie Institution, which, within ten years from this date, expects to complete substantially a magnetic survey of the entire world. Its results will be published in the form of a series of charts, for use by navigators.

There are a number of lines along which the compass needle always points due north. Everywhere else it points more or less away. One of these lines

DR. L. A. BAUER AT WORK ON THE DECK OF THE *Galilee*.

runs through the State of Ohio, about half way between Columbus and Cincinnati, through the eastern part of Kentucky and Tennessee, through South Carolina, and passes out over the Atlantic Ocean near Beaufort. At places east of the line the compass needle turns towards the west; at points west of the line its variation is toward the east. On the northeast coast of Maine the needle points as much as twenty-one degrees west of the true north; at Vancouver it points twenty-five degrees east of north.

THE "DIP CIRCLE."
The compass set so as to point toward the magnetic center of the earth as well as to the north.

No wonder, then, that magnetic variations have long been a puzzle and an exasperation to navigators. And, to complicate the problem still further, the magnetic pole is not stationary. It is continually moving, though at a slow rate —a phenomenon the cause of which is as yet unknown. But, owing to this fact, the partial surveys made by different governments at various periods do not

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piece together satisfactorily, as it were. Respecting the law governing this change, nothing definite is understood, but the scientists of the Carnegie Institution are trying their best to study it out. So far, it is not even known in what direction the magnetic pole is moving.

Although the *Carnegie* is brigantine-rigged, with 12,900 square feet of sail, she is powerfully engined also. The greatest puzzle in the building of her was the power question. Steam would not do, because the requisite plant would be highly magnetic. Gasoline or oil would not serve, because the large quantities of such fluid fuel needed for long voyages in out-of-the-way seas might be dangerous. Accordingly, it was decided the only thing to do was to equip the vessel with a marine gas-producer specially constructed for the purpose, capable of using coal, in connection with a bronze internal-combustion engine.

MEASURING THE FORCE OF MAGNETIC ATTRACTION.

The cylinders of the engines have thin cast-iron liners, for wearing purposes, and steel cams for the operating valves. These, weighing altogether less than 600 pounds, comprise nearly all of the steel and iron on board of the ship. The gas-producer is a cylindrical copper shell, lined with a special grade of firebrick. A shaking grate of manganese steel—practically non-magnetic—supports the fuel bed. Water for cooling the gas is supplied by a bronze pump attached to the engine shaft. All fittings and gas-piping are of copper or manganese bronze. The cylinders, water jackets, and heads of the engine are of brass. The engine base, connecting rods, valve stems, and igniter box are of manganese bronze.

The vessel is sub-divided into seven water-tight compartments by six transverse bulkheads. If two of these compartments should be stove in, she would still float. Immediately aft of the collision bulkhead is the forecastle, with comfortable space for eight men, who have a bathroom of their own. Next abaft is the crew's galley; then the officers' messroom, staterooms, and bathroom; then the quarters of the scientific staff, occupying the full width of the ship—36 feet, 6 inches—with wardroom, 25 by 11½ feet, and five staterooms. Abaft of the wardroom is the steerage, with galley and bathroom.

The bathrooms on board are small but luxurious, with porcelain tubs and wash basins. All the plumbing is of non-magnetic materials; likewise the ranges in the galleys, and the culinary utensils. There is an ice-making and refrigerating plant, the structural materials for which are bronze, brass and copper. Fresh water is carried in wooden tanks under the cabin and floor of the forecastle, which, containing 6,000 gallons, are fitted with piping to all parts of the vessel. The balance of the space under the floor is occupied by compartments for the storage of various kinds of supplies.

On the deck is an observation room, at each end of which is a circular observatory, 7 feet, 8 inches in diameter, crowned by a revolving dome of bronze and plate glass. The observatories are

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THE YACHT *GALILEE* AT SITKA, ALASKA, IN USE BY THE UNITED STATES MAGNETIC SURVEY CORPS.
She has been displaced by the *Carnegie*.

equipped with every imaginable instrument for the work they have to do, one item of the apparatus being a "dip-circle" —a magnetic needle swinging on a horizontal axis, with jeweled bearings, which is used to measure the total magnetic intensity and the amount of magnetic force exerted upon the ordinary compass needles used on ships. To determine the variations of a compass at a given place and time, a standard compass is employed, with an azimuth circle—the azimuth enabling the observer to get the bearing of the sun or other fixed heavenly body. This, with known data obtainable from nautical almanacs and simple observations, enable the watcher of the skies to find the true north and south meridian and the local compass variation.

All the instruments are so constructed as to be not at all affected by the rolling and pitching of the vessel. Observations of three kinds will be made, with a view to ascertaining the magnetic variations of the compass needle, the dip of the needle toward the magnetic pole, and the force acting upon the magnetized needle.

It ought to be explained that the magnetic survey work now being conducted by the Carnegie Institution is by no means restricted to the activities of a single vessel, with its scientific staff. For the accomplishment of the same ends, the Institution has now in the field two expeditions in Africa, one in Persia and Asia Minor, one in China, and has already covered part of South and Central America, as well as British North America and Greenland.

As already explained, the work, which is under the charge of Dr. L. A. Bauer—formerly of the United States Coast and Geodetic Survey—will be completed in about ten years from the present time.

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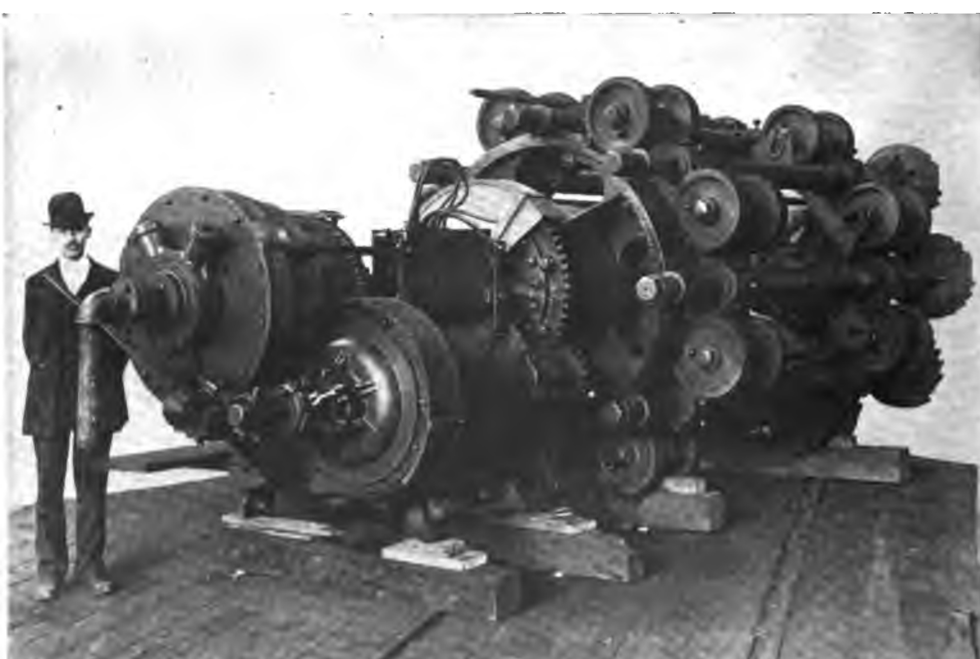
MACHINE THAT TUNNELS THROUGH STONE

By ROLAND ASHFORD PHILLIPS

TO put a hole through a mountain quite as easily as pushing your finger through a mud ball; to set a marvelous, almost human machine against a solid breast of rock and watch it eating its way out of sight and hearing, is the final accomplishment of Mr. R. B. Sigafoos, a practical machinist, a former associate of Thomas Edison, and long connected with well-established firms in the manufacture of labor-saving machinery.

Tunneling machines are by no means a rarity, for since 1853 no less than sixty-nine patents have been granted on these inventions. About sixty of these reached no further than the blue-print stage, while a bare half dozen were finally given birth as actual working models. None of these six has proved a finished success. Each featured a new point or two, demonstrated a previous unknown principle, but lacked that one definite essential that would make it a perfect achievement.

Mr. Sigafoos, warned by these previous failures, went to work on virgin grounds. And today his eight foot machine, now at work in Colorado, and which the writer was fortunate enough to witness in actual operation, proves that his theory is the right one, and that his method of driving bores, either for min-



THE TUNNEL DIGGER AS SEEN FROM THE REAR. SHOWING THE MOTOR.
The machine is operated by one man.

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ing or irrigation purposes will completely revolutionize all tunnel work.

Recent tests have shown, exactly as the inventor prophesied, that an inch penetration for every minute run was not a difficult achievement. Five feet an hour, through solid rock, is a statement sufficiently startling to cause any reader to sit up and take notice.

The machine proper weighs twenty-nine tons and is eighteen feet in length. Upon this huge frame the ten crushing or cutting heads are carried, each of these being on a four inch horizontal shaft and working on the same idea as the stamps in a stamp mill, the blows being lent by a spring instead of force of gravity, as in the former instance. The entire machine revolves, and in doing so cuts a full bore, clean. The cuttings or muck are flushed from the breast and back to the tunnel-mouth, by means of a three inch stream of water under forty pounds pressure. This water is fed through a central shaft and discharged through a spray-head, which same holds ten five-eighths inch nozzles and these direct a constant stream beside each cutting head. The whole machine revolves on "feet-wheels," there being sixteen pairs in all. The axles on these wheels are arranged so they can be set at will, in order that the wheels will not track, but instead, describe helical paths and thus move the machine forward or backward, at any desired speed. The great weight of the machine keeps it ever pushing forward like a huge screw.

THE ROTARY TUNNEL MACHINE AFTER IT HAS WELL EATEN ITS WAY INTO THE ROCK.
The hose carries the water required in drilling to the face of the drift.

Should one of the crushing heads break or wear out, the axles of these "feet wheels" are set at a reverse angle and the machine promptly backs out a sufficient distance to allow the men to go through the framework, gain the space between the breast and the stamps, and attend to matters. It may be noted right here that this is the only tunnel machine so equipped.

The rear ends of the cutter shafts carry tappets which are acted upon by a revolving cam. This draws back the tappets and releases them. The drop can be varied to either four, eight or twelve inch, by simply changing the cam.

Eight of the ten crushing heads are on the outside of the revolving front, while two are in the center. The cam has a long barrel-like hub which permits the central shafts to be brought back by their cam without interfering with the larger one. Diametrically opposite cutters strike at the same time. The cam proper is five feet in diameter.

The springs which strike the blow are five feet long, six and one-half inches in diameter and made of inch steel. To prevent the cutters from pounding the front head when the machine is back from the breast, a buffer spring is utilized.

The cutting, or crushing heads are two feet in diameter and five inches thick, striking a blow of four thousand pounds, two hundred times a minute, meaning a grand total of eight million pounds expended against the breast of the tunnel each sixty seconds. Each head needs but to crush the thickness of a sheet of writing paper in order to accomplish this penetration of an inch a minute. The harder and more stubborn the rock the better—in fact the same rate of speed cannot be held in soil or soft, clay-rock.

These heads have a series of blunt teeth, for the idea that is carried out is to pulverize the rock instead of to cut it. The heads revolve about the axis of the machine as they strike, thus producing a grinding motion to the surface of

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the breast. In this one unique respect this rotary machine differs from all others, and in this, too, lies the secret of its success. A sharp edge can never be used to any advantage without the constant halting and sharpening.

The machine is operated by a one hundred and fifty horse-power motor, although a sixty-five power one is sufficient when once in motion; and as this motor is mounted on wheels and of course follows the cutting head, the necessity of extensive power houses is done away with. Only two men are required for each machine, a driver or motorman, and a helper. A single lever controls all movements.

During the recent severe tests the inventor considered the idea of increasing the weight of the machine, in order to better overcome the force of the continuous two ton blows. This rotary machine already weighs ten times as much as any other, yet hopeful inventors talk of boring a tunnel with a machine that weighs but a few thousand pounds. These tests have shown the utter impossibility of such a model to work.

The amount of money, labor and time to be saved by this new tunnel machine is almost incredible, unless one takes it item by item. In the first place there will be no further need of expensive timbering, for the machine cuts the walls as smooth as dressed marble, instead of shattering them by heavy and constant explosions. Next, all powder and fuse are saved, and any miner will tell you that this is fully a third of the cost of putting in a bore. And lastly, but as important as any of the former, there will be absolutely no danger.

R. B. SIGAFOOS, INVENTOR OF THE ROTARY TUNNEL MACHINE.

In the matter of wages, two men can run the machine a single shift of eight hours. Working twenty-four hours a day, and using three shifts means a total of about $24. As it stands today, in running the ordinary tunnel, say four by seven feet, there is needed two drill men, a mucker, several timber men and possibly one or more others, bringing the total in wages alone up to $65. Now this latter crew in their twenty-four hours can cut about twelve feet, making each foot cost close around seven dollars. This, mind you, for wages alone, and not for the expensive supplies. This tunnel machine, costing for labor, but $24, will, in the same length of time, cut 120 feet, at the cost of but twenty cents a foot. The immense amount of saving is too plain to need further examples.

If, in boring a long tunnel a pay vein is run across, the pulp, or muck, which is washed out by the water, can be run out onto a large concentrating table at the tunnel-mouth, a rough separation made, and then, running these concentrates on over a standard table, every bit of color can be saved.

It is not necessary, as one might first surmise, to operate the tunnel machine on new properties. This rotary can easily be taken to pieces, packed any distance, lowered into any shaft and set up again in the drift ready for work.

For irrigating and ordinary mining and drainage work, the eight foot machine is practical, but for work requiring a larger bore, such as a railroad tunnel,

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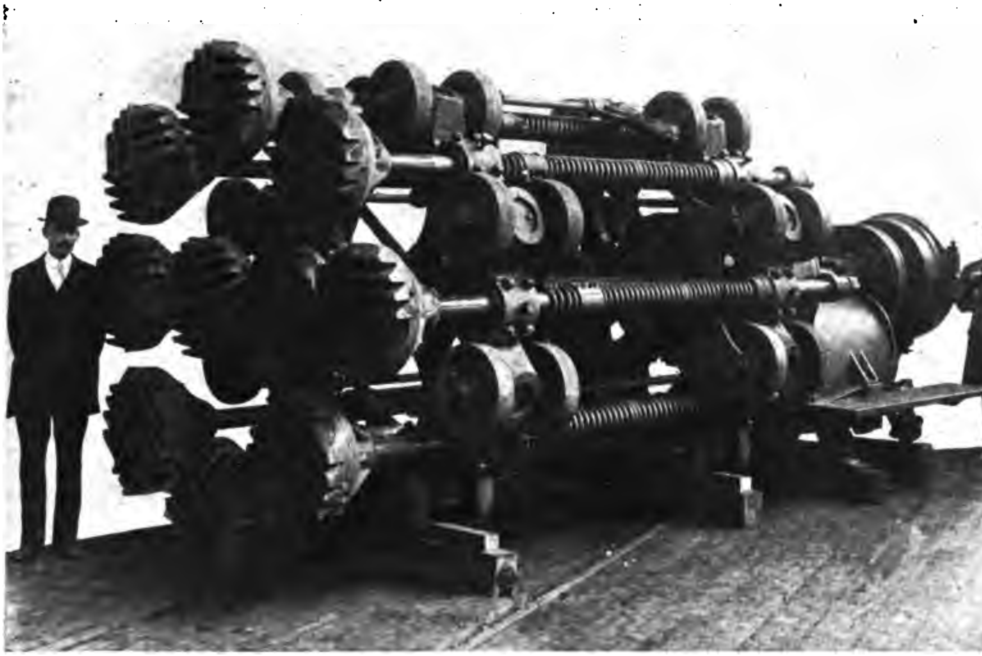

A FRONT VIEW OF THE TUNNEL DIGGER. SHOWING THE TEN HUGE STAMPS AND THE SERIES OF WHEELS WHICH CARRY THE MACHINE IN ITS ROTARY MOTION.

an eighteen foot machine is necessary. These latter rotaries are eight feet longer than the smaller size, have thirty-six stamping heads, each of which is twenty-seven inches in diameter. In finishing a railroad tunnel, of course the bottom would have to be squared, but this work would prove very simple, and would lower the bottom four feet. This result would make the bore eighteen feet wide and twenty-two feet high. Two eight foot machines working side by side could be utilized if necessary—or even three. There is practically no bounds to the size of the tunnel, providing there is mountain enough.

The immediate uses to which this rotary tunnel machine could be put are so many and varied that no one could well describe a tenth of them. However the first and foremost of these will instantly be recalled to the American mind —namely, the Panama Canal. Already the Isthmian Canal Commissioners, quick to see the immense advantage gained by this new invention, have asked Mr. Sigafoos to submit bids on finishing the great Culebra Cut, which, when completed will be over seven miles long, two hundred and ten feet deep and two hundred feet wide at the bottom. And the inventor's statement of the fact that he can save the government something like twenty-four millions in money, and at least four years' time can not be easily disputed when one has witnessed the machine in actual operation.

Subways, similar to those cut out of solid rock in New York City, can be bored almost while we wait, at a fraction of their former cost and without the stupendous preparations and vast amount of trouble and danger.

Water can now be brought in from a thousand different sources through what previously proved to be impossible barriers; and that which is now but a limitless stretch of sand and sagebrush will ultimately become a farmer's paradise.

For the famous Moffat Road, running from Denver to Salt Lake, has been built a temporary track over the Great Divide, reaching the elevation of over thirteen thousand feet, while the completion of the monster tunnel is awaited,

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which will cut under the entire range and shorten the trip to the west coast by at least twenty-four hours. The contractors on this gigantic undertaking immediately saw the advantage of this rotary tunnel machine and have entered proposals for their installation. And what appeared to be a ten-year job will now be accomplished in less than two years.

And in this final paragraph it is not amiss to say, and not too broad a statement to make, that this new rotary tunnel machine will accomplish in one month what previously took a year, and at fully one-half the present cost.

NEW TYPE-SETTING MACHINE MAKES GREAT SPEED RECORD

By K. H. HAMILTON

TO build a type-setting machine that would use ready-made type and thus do away with the use of melted metal and power, has been the ambition of quite a number of inventors for some time past. Many difficulties, however, have beset their path to success, but A. G. Baker, the inventor of a new type-setting machine, seems to have overcome the many difficulties and now has on exhibition a machine which not only operates without power or fire, but will set foundry-made type faster than any other machine of its kind thus far produced.

The machine is a very compact one measuring only sixteen inches long, sixteen inches wide and twenty-eight inches high, yet it has a capacity of ten lines a minute of ordinary one column length to six lines a minute of the fastest machines now in use. Technically speaking, it will set 10,000 ems an hour, as against older machines 6,000 to 7,000. Its weight is only 125 pounds.

The upright portion of the machine, called the magazine, consists of ninety channels, containing the different letters of the alphabet, punctuation marks and other characters used in printing. Each channel is just wide enough to contain the character allotted to it without allowing it any more room than is necessary to slide up and down easily. The channels are entirely independent of each other so that any one of them can be removed from the machine instantly if desired without disturbing the others.

The first channel at the right is eight inches long and each succeeding one is one-eighth of an inch longer, thus making the lower end of the magazine inclined from right to left, the top being level.

The type is set by pressing the keys on a key board similar to other type-setting machines. When a key is pressed it operates a plunger which enters its corresponding channel from the rear and pushes the lower piece of type out into the inclined guide plate in front, whence it is carried by gravity to the assembling point.

The guide plate is so tilted that those characters which are farthest from the assembling point will travel fastest when released from the magazine, because of the greater inclination of the plate at that end, while those nearer travel more slowly so that all arrive at the assembling point in the same time. This enables one to operate the machine very rapidly without danger of transposing letters.

As the letters reach the angle in the guide plate at the lower left hand corner, an ingenious piece of mechanism places each letter on its feet in a line ready for

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removal at such time as may be desired.

One of the most interesting features about the machine is the distributing device which operates to and fro on the top of the magazine, similarly to the carriage of a typewriter. This part of the machine contains a number of channels like those of the magazine. In each channel a line of type is placed for distribution and the distributer moves across the top of the magazine one space at a time, actuated by the motion imparted to the keys in setting the type.

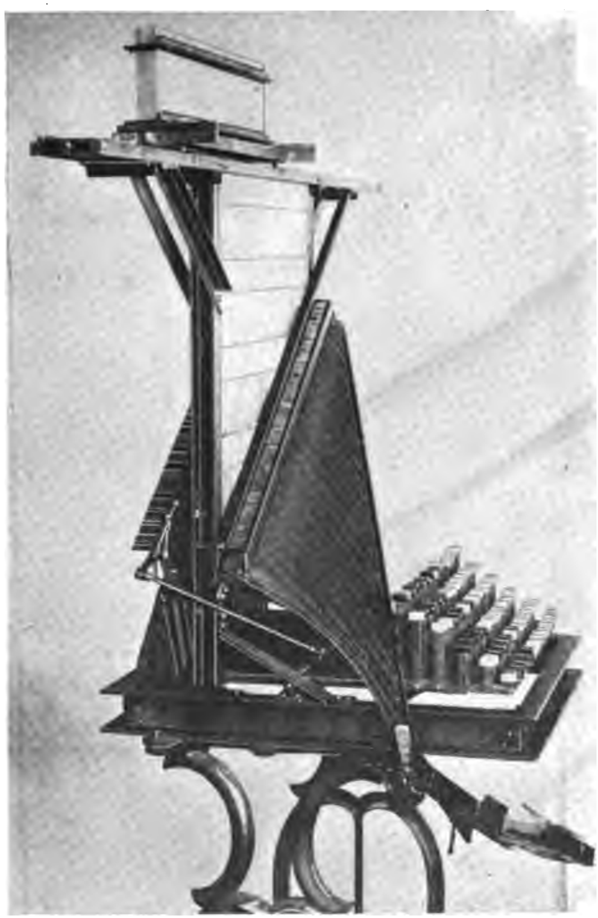
At the top of each channel of the magazine and extending about one-third of the way across the opening are steel strips, called "wards." Each ward has a number of protuberances upon its surface corresponding in shape to a number of nicks on the side of each type character. The ward and its corresponding type character will fit each other perfectly, but neither will fit any other except its own counterpart. As the distributer passes across the top of the magazine each piece of type is tested against the wards until it eventually finds its corresponding ward and falls into its own channel.

In this way type may be distributed by the operator without any extra effort on his part, coincident with the setting of a new form.

The machine is so constructed that it will set all standard sizes and styles of type, but type having different sized bodies cannot be used in the same machine. Type having the same sized body but a different face, however, may be used indiscriminately.

The fact that the machine requires no power for its operation and no gas or other heat for melting metal, makes it particularly well adapted for the use of country newspapers which have been unable heretofore to adopt such conveniences because these facilities were lacking. Its size and weight also permit it to be moved about the office as necessity demands.

The simplicity of the machine is also a strong point in its favor. While it is not easily gotten out of order, still if such a thing should occur, the services of a skilled mechanic are not required to repair it, such repairs being easily made by the operator.



THE NEW TYPE-SETTING MACHINE.

The machine is most advantageously operated by two men. One setting the type and the other spacing the lines, or justifying them as it is called. Corrections in proof are more readily made from the ordinary case of type, as this method requires less time than making changes on any type-setting machine.

Throughout the tests thus far made with the machine by printers and type-setting machine operators from various parts of the country nothing but words of praise have been said of it, and the inventor has received many letters of congratulation both from this country and abroad. There is every reason to believe that the machine will find a ready sale when it is placed upon the market.

FIRST AMERICAN MONORAIL

By P. HARVEY MIDDLETON

A FEW miles from New York they are just starting to build a little line which threatens to revolutionize railroading in this country, and to relegate to the scrap-pile the two-truck railroad, the ponderous coal-eating locomotive, and the big heavy eight-wheeled cars, as companions to the stage coach and the paddle-wheel steamboat. It is America's first monorail road, and in a few months' time this pioneer of the novel single-track system will be carrying passengers between Bartow Station on the New Haven line and City Island—a distance hitherto covered by ancient horse cars.

The monorail cars, with their cigar-

THE MONORAIL HAS POINTED ENDS TO LESSEN AIR RESISTANCE.

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shaped ends, will be fifty feet long and six and a half feet wide, and will run on four wheels placed under the car tandem fashion, two on each end, each wheel having double flanges and being driven by two separate motors—eight motors in all. These wheels run on a single rail spiked to concrete ties. Above the car at each end is a flexible arm connected with an X-shaped truck, each truck containing four guide wheels, which run in two L-shaped overhead rails so arranged that the guide wheels cannot leave the rails without taking something apart. These guide rails, which are kept a uniform distance of thirty inches apart, conduct the electricity, leaving the single running rail safe to animal and human life.

LOOKING DOWN ON TOP OF THE MONORAIL CAR.
This view shows the overhead guide-rails to advantage.

It is claimed that this American system of overhead guide wheels and the single rail beneath the car result in possibilities of high speed without oscillation and a saving in power. It differs from the French and English systems, all of which require the use of guide rails beneath the car in addition to the running wheels, and also from the German system, in which the carrying rail is overhead, the car hanging suspended underneath.

The dominating principle of the American monorail is that the weight of the car and its load is transmitted to the single rail beneath the car, while the horizontal forces, such as result from unequal loading, centrifugal force, and side winds, are transmitted to the overhead

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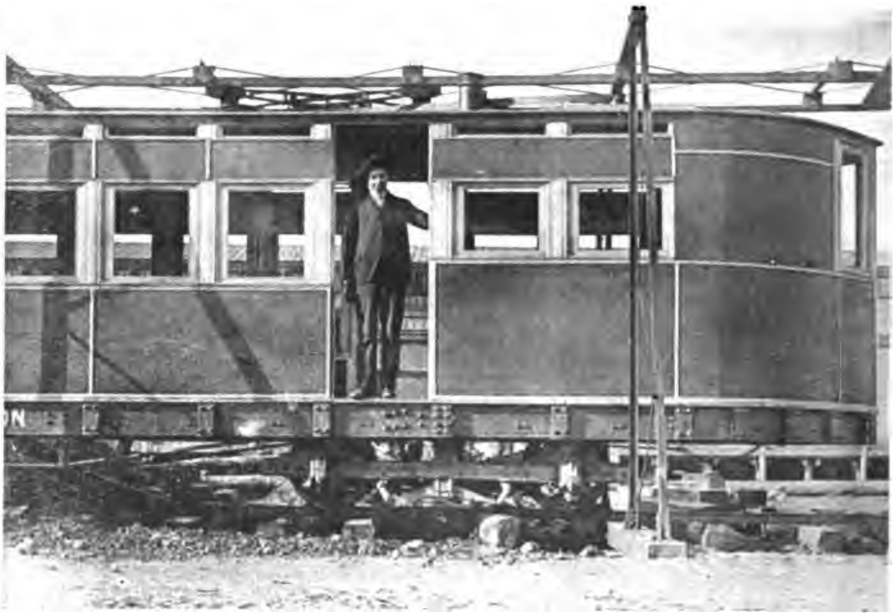

THE SIDE DOOR IS ALSO A USEFUL FEATURE OF NEW DESIGN.

guide wheels. In effect this results in the car being securely fastened to the overhead guide rails, while the double flange wheels beneath the car give it a firm grip on the single rail.

It is in reality a railroad with cars built to operate on the principle of the bicycle, and will meet electricity half way in its tremendous speed qualities, which the present ponderous cars with their parallel rows of wheels—a relic of the primitive ox cart—can never do. It is impossible to maintain a pair of rails exactly horizontal; there must inevitably be a jerking of the train from side to side, which at high speed becomes exceedingly dangerous, because whenever the level is not perfect there is a tendency created to lateral impact against one rail or the other.

It has been said by some of the world's greatest engineers that a speed of over one hundred miles an hour can be obtained by the American monorail with absolute comfort and safety, at a first cost of thirty per cent less than standard gauge railroads, and a saving of over twenty-five per cent in operating and maintenance. As the Hon. John H. Starin, former vice-president of the Rapid Transit Board, says, to put electricity on our present unwieldy cars is like hitching a thoroughbred with a dray horse. They don't belong together. The monorail goes naturally with electricity. It is equal to it. Once we have these two properly harnessed there is no doubt we shall make new and astonishing achievements in every branch of land transportation. Steam trains and two-rail electric trains can be, and often are, run eighty miles an hour or faster, but it is only by a vast expenditure of power, invariably producing a great strain on engines and cars, rapidly destroying roadbeds and bridges, and always accompanied by a great element of danger ever increasing with the speed.

The monorail car can make one hundred miles an hour with ease and safety, and being economical it is likely soon to be in great demand, multiplying ideal

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INTERIOR OF THE AMERICAN MONORAIL CAR.

means of communication. The forward motion, together with the gyroscope-like force of the driving wheels, will maintain perpendicularity without the help of the guide rails, which are in reality merely safeguards when the car is at rest, and give it proper lean at curves. The monorail car loaded with passengers is much lighter than a loaded car of the same passenger accommodation of the present type, and consequently possesses corresponding economy in the power required to drive it at a given speed. According to railroad men, from fifteen to thirty per cent of the power used to operate trains is lost in the sideways swinging motion of the cars. The monorail train will have a straight ahead motion without any side swing.

A striking advantage of the new system is that it can be built almost anywhere in a narrow city street, because it has only one rail and takes up very little room. It can be built without regard to the hard problem of grades, and can be laid down in rough and inaccessible country, and can be operated during snow or sleet with much more efficiency than can be obtained by any other system. It is claimed that a monorail line can be established between any two towns at a fare rate of half a cent a mile and a speed of one hundred miles an hour, which ought to satisfy even this hurrying age. Magnetic brakes will stop the cars in emergencies in half the distance required by air brakes. Certainly the monorail would seem to be the coming car.

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FINDING AND CUTTING OF THE GREAT CULLINAN DIAMOND

By FRANK N. BAUSKETT

THE Cullinan diamond which was recently presented to King Edward of England by the Transvaal government on the occasion of his sixty-sixth birthday is the largest, the most brilliant and flawless diamond in existence.

In the original state the Cullinan diamond weighed 3,253¾ carats, or over one and one-third pounds. In the process of cutting and polishing it was divided as follows: A pendeloquem or drop brilliant, weighing 516½ carats, 2.322 inches long and 1.791 inches across; a square brilliant, weighing 309¾ carats, 1.771 inches long by 1.594 broad; a pendeloque, weighing 92 carats; a square brilliant, 62 carats; a heart-shaped brilliant, 18⅜ carats; a marquise brilliant, 11¼ carats; a marquise brilliant, 8 9/16 carats; a square brilliant, 6⅝ carats; a pendeloque, 4 9/32 carats; 96 brilliants, weighing 7⅜ carats, and a quantity of unpolished "ends" weighing 9 carats.

The first and second of these stones are by far the largest in existence. Even the second one is much bigger than the previously known brilliants, viz., the Jubilee, weighing 239 carats, while beside either of them so famous a jewel as the Kohinoor sinks into comparative insignificance, since its weight, 106 1/16 carats, is little more than one-third of that of the smaller, or one-fifth that of the larger. Moreover, the stones are not more distinguished for size than for quality. All of them from the largest to the smallest are absolutely without flaw and of the finest extra blue-white color existing.

CUTTING THE CULLINAN DIAMOND IN TWO.

In its rough state the Cullinan was irregular in shape, and it was without doubt only part of a much larger stone, for there were indisputable evidences that on three sides large pieces had been broken off. In fact, by many of the experts who handled it it is

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Two Views of the Original Stone.

believed that it was only a small piece of a very much larger stone, but there was less possibility of reconstructing it than to reconstruct the statue of Venus de Milo. Perhaps, however, the mystery may some day be solved by the other pieces of the stone being found.

In recent years when large stones were discovered it has been a problem as to what disposition should be made of them. This was notably so in the case of the Jubilee and the Excelsior, but when the Cullinan was discovered the problem was further complicated for it was out of the question that any individual buyer could be found for it, as its value in the rough was three-quarters of a million dollars—in other words the stone was priceless. Of course it could have been broken up into marketable size pieces but such a course would have greatly diminished its value; and so pending a decision of the best adjustment to te made of it the diamond as large as a tumbler was sent to London to repose in the vaults of the Rough Syndicate for safe keeping. Then the Transvaal government conceived a happy thought of presenting the gem to King Edward, and so the historic pebble becomes the property of the Crown of England.

After the decision was reached to present the King with the diamond the serious question arose as to the manner in which it should be cut and polished, for an unpolished stone to the unpracticed eye has about the same luster as a piece of camphor. With this end in view the great diamond firm of J. Asscher, of

THE STONE CLEFT INTO SEVERAL PARTS.

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THE MEMBERS OF THE ASSCHER FIRM STUDYING THE BEST METHOD OF SPLITTING THE CULLINAN DIAMOND.

Amsterdam and Paris, was brought into requisition.

This firm was originally started by the father of the present manager, who descended from a long line of diamond workers. This diamond factory is the largest of its kind in the world, and surely the best adapted to have undertaken such a complicated and intricate work as the cleaving and polishing of a diamond such as the Cullinan. The stone was consequently turned over to the Asschers to do with it as their good judgment might dictate. After the diamond was received at the factory it was photographed in all possible positions. And after a long and tedious examination and consultation it was found that two important and other minor flaws existed in the stone which made it necessary that it be cleaved in certainly two and perhaps more pieces. Such a task carried a responsibility that even the most expert diamond cutter would be reluctant to assume, but it was decided that of all the diamond experts in Amsterdam Joseph Asscher was the one who could best be trusted with the work. Casts were made of the stone, both in clay and in crystal, and numberless experiments were made in cleaving these casts in order to ascertain what would happen when the original stone was cleaved. The master hand was soon in possession of just what was necessary to be done. Two incisions were made with an American sawing machine along the grain to a depth of one-half to three-quarters of an inch, and when the fateful day arrived, Asscher with a specially constructed knife-blade made of the finest steel, and covered up to the neck with an apron to save any of the flying precious pieces, inserted it into the slit and with two terrific blows cut the stone in twain exactly along the grain and through the flaws precisely at the point he had calculated. Such good fortune

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does not always follow the cleaving of a diamond. It sometimes happens that when the stone is struck with the blade that cleaves it, instead of splitting along the grain, it flies into a number of pieces. Imagine then Asscher's joy when his work was successfully executed and he saw in two of the pieces possibilities of making two diamonds larger than any stone before dreamed of. In speaking afterwards of his achievement he was asked if he had not felt nervous before striking the fateful blows; but he replied that it was only after his work was accomplished that he realized what strain he had been under, and for three nights never closed his eyes.

After the operation of cleaving the stone was completed the question of polishing it came up. A specially built room for the polishing was constructed, and it was there that the now celebrated Koe took up his quarters, and for nine months from seven in the morning until nine o'clock at night, without interruption, and every day in the week except Saturday, he stood to his task watching the precious stones being ground into shape on a mammoth disc revolving at the rate of 2,700 revolutions a minute. In the enclosures he was guarded by two detectives and another stood at the door barring the entrance to any one. The process as may be imagined was intensely absorbing, for the slightest mistake would have meant the loss of thousands of dollars, and more than that the reputation of the diamond firm. But the faithful Koe stood to his task day in and day out, hour after hour, watching with jealous care his charge, until the disc ceased to revolve and his work was done, one of the most intricate and nerve-racking tasks ever undertaken. In general all diamonds, or so-called brilliants, are given fifty-eight facets, but in order to bring out the prismatic fires in the Cullinan seventy-six facets were given to it.

THE STONES AFTER COMPLETION.

The Premier Diamond Mine in South Africa where the Cullinan was found is comparatively new, having only been worked since 1902. It has, however, already produced over $25,000,000 worth

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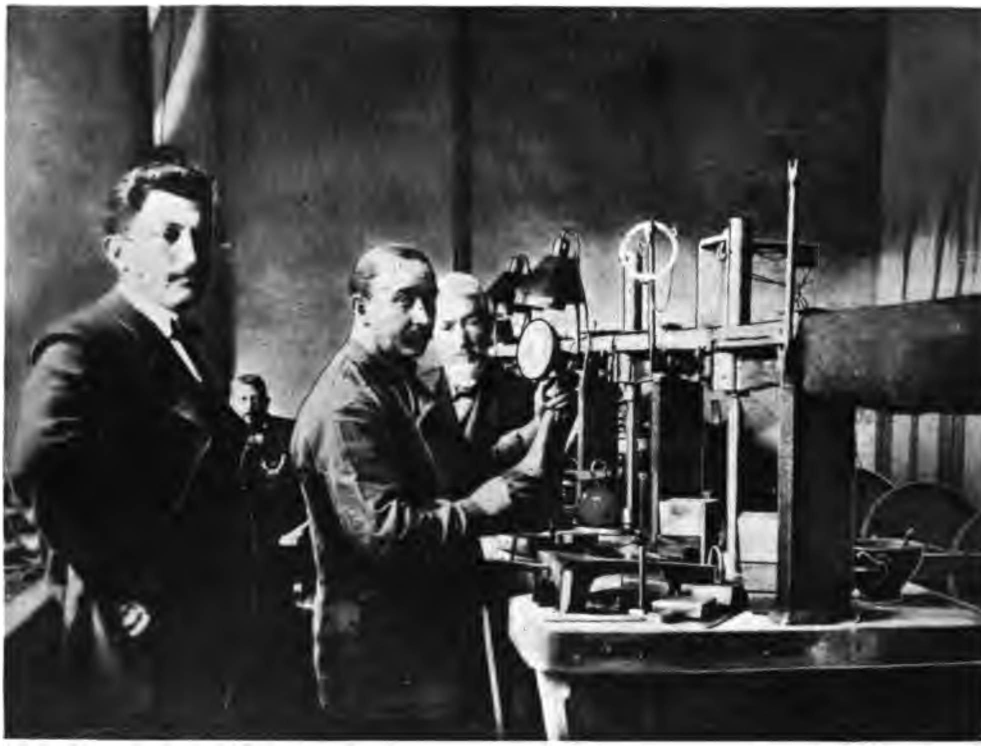

ROOM SPECIALLY BUILT FOR POLISHING THE CULLINAN DIAMOND.

of the precious stones, and its size is so enormous that it is feared by other diamond mine owners that the output of the Premier in the future will seriously affect the diamond market. This great mine as yet has only been worked on the surface, and when it is considered that it can be worked for thousands of feet deep its estimated value is beyond man's comprehension.

There is no romance surrounding the finding of the Cullinan diamond. It simply happened that one of the foremen of the Premier Mine was strolling for an afternoon walk over the premises of the company one bright day when he saw the rays of the sun glinting back from the ground from a point a short distance ahead of him. Approaching the spot which beckoned him, he took out his jacknife and dug up the huge stone—a diamond in the rough as big as his two fists. When he had time to realize what great wealth he had in his possession he was taken with a violent nervous chill. He soon recovered his strength, however, and hastened to the manager of the mine and placing the stone on the desk before him exclaimed: "My God, look what I've found!"

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THE APPLE-PIE IN DANGER

By F. G. MOORHEAD

A VERSATILE and picturesque statistician of the Spokane Chamber of Commerce has figured out—and being a married man he doubtless has had help at home and is not to be disputed—that if the apples harvested last year from the commercial orchards of the United States were converted into pies the army of bakers needed to do the work would turn out 6,250,000,000 of them and that these placed side by side would make a path of almost 975,000 miles, enough to girdle the earth thirty-nine times.

Not satisfied with this succulent solution, he asserts that the total weight of this mountain of pastry is estimated at 9,250,000,000 pounds, including 6,125,000,000 pounds of flour, lard and other ingredients in the popular American after-dinner dessert, requiring 154,166 cars of standard capacity to transport them from the ovens to the consumers.

But last December the National Apple Show was held at Spokane, and some interesting figures came to light in connection with it. The Spokane country alone shipped 8,000 carloads of apples last year, while in 1909 the output is expected to pass the 10,000 carload mark. On the 27th of February, 1908, the London fruit exchange quoted Washington and Oregon apples highest, rating them at $3.14 a box, or $9.42 a barrel, the nearest competitor being California

THE FANSLER ORCHARD, ON THE PRAIRIE NEAR OKANOGAN, WASHINGTON.
One of the fine orchards of the North-West.

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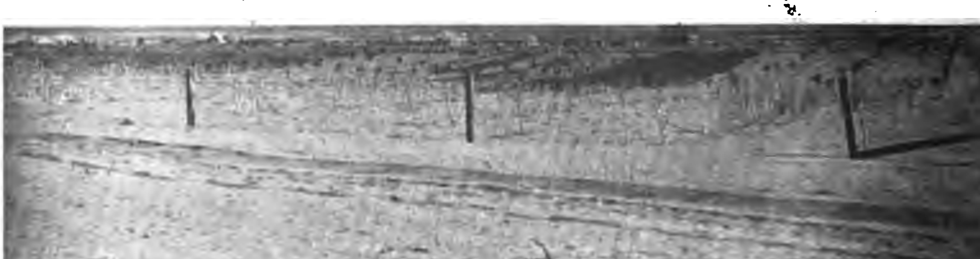
AN ORCHARD OF THE NORTH-WEST, YOUNG BUT DEVELOPING RAPIDLY.

A FEW OF THE "ORDINARY" APPLES THAT OREGON PRODUCES.



A NEWLY-PLANTED ORCHARD, NEAR HERMISTON, OREGON.

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apples at $1.96 a box, or $4.88 a barrel. On the same day New York apples were quoted at $1.36 a box, or $4.09 a barrel.

During the year, while the crop showed a falling off of practically fifty per cent in New York, New Jersey, Maryland, Missouri, Illinois, Indiana, Arkansas, and Massachusetts, in the Pacific Northwest it was almost normal, the decline from 1907 being in no case more than fifteen per cent.

To show the decrease in the production of apples in the Union in the last twelve years, these figures, compiled by the Federal Department of Agriculture, are quoted: The growers produced 60,540,000 barrels of commercial apples in 1895 and 69,070,000 in 1896, the banner year in the history of the country. This was a matter of 177,725,000 bushels, or more than nine pecks per capita. There was a decrease of nearly 28,000,000 barrels, or more than the entire crop, in 1897. In 1898 the yield was placed at 28,570,000 barrels, but in the next two years, 1899 and 1900, there were substantial increases, placed at 37,560,000 and 47,960,000 barrels respectively. There was a drop of 20,890,000 barrels in 1901, while in 1902 there was an increase of 20,655,000 barrels, the crop being estimated at 47,625,000 barrels. Forty-five million barrels of fruit were produced in 1903, and in 1904 the yield was 300,000 barrels greater. Then, in 1905, it dropped to 23,500,000 barrels, and in 1906 it increased to 36,130,000 barrels. The crop of 1907 fell off to 25,000,000 barrels, which is about the yield for the year 1908.

The Other Thing Always Best

Wedlock, indeed, hath oft compared been
To public feasts, where meet a public rout,—
Where they that are without would fain go in,
And they that are within would fain go out.

—Sir John Davies.

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ENGINEERING PROGRESS

BIGGEST LATHE IN THE WORLD

FOR this mammoth lathe, recently constructed by Ernst Schiess at Dusseldorf, Germany, is claimed the distinction of being the largest ever built.

Being intended for the turning of samples up to 40 feet in diameter and 11.42 feet in height, this lathe comprises a plane disc 36 feet in diameter which is operated from an electric motor, wound for several speeds, through several toothwheeled gearings by their milled steel toothed rims. While simple in construction and of relatively small space requirements, this lathe allows five sets of speeds.

The plane disc, which is supported in its center by a spindle and pivot, runs on a surface dealing with any lateral thrusts, while deformations are prevented by special adjustable supporting jacks arranged at its outer circumference. It will be readily understood that, in the case of so large a machine, the departures from the usual design were necessitated in many details with a view specially to increasing the ease of operation. The throwing in and out of gear and the controlling of the driving motor as well as the altering of the switching speed are thus effected, in the present case, from the mechanic's stand situated at the level of the transversal slide, thus dispensing with any necessity for the

MONSTER LATHE LARGE ENOUGH TO SEAT 227 MEN.

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mechanic to climb down from the machine with a view to carrying out these operations. Special safety devices are further provided for preventing collision.

The tool-holders are provided both with the usual hand adjustment and a quick mechanical adjustment. The compensating counter-weights of the tools are fitted immediately to the tool-holders which arrangement, while not being new in principle, has hardly ever been used in the case of lathes of this kind. As it is, this arrangement ensures to the machine a more pleasing appearance in opposition to the usual design with chains or wire ropes running alongside the transversal beam or at right angles to the upper transversal beam.

LATHE WHICH WEIGHS THREE HUNDRED TONS.

The weight of the machine is 300 tons. The constructor has recently completed nine lathes of the same kind.

The first illustration, which shows the lathe with 227 workmen on it, gives a striking idea of its huge size.

MODERN REINFORCED CONCRETE SEWER

REINFORCED concrete sewers are now being built in either flat top, circular or curved construction, ribbed. Metal is utilized for the reinforcement which usually extends entirely around the sewer, the main ribs being in direct line of the greatest strain, while the cross members thoroughly reinforce the concrete against any shrinking or settlement cracks.

The illustration shows reinforced concrete sewer construction at St. Paul, Minnesota.

Owing to its rigidity and stiffness the rib metal will stay in the forms exactly where placed and cannot be dislodged in pouring the concrete. In this particular sewer the rib metal is utilized in sheets nine bars wide and is said to be very easily held in place in the forms. Each rib is nine hundredths of a square inch in area with an ultimate tensile strength of 6,480 pounds, and a safe tensile strength of 1,620 pounds.

The rib metal has an ultimate tensile strength of 9,720 pounds per foot of width and a safe tensile strength of 2,430 pounds per foot of width. Reinforced concrete is now considered ideal for sewer construction.

REINFORCED CONCRETE SEWER UNDER CONSTRUCTION AT ST. PAUL, MINNESOTA.

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AUTO TO SHOOT BALLOONS

MEANS have been found to effectively fight dirigible balloons and aeroplanes.

This has been done by designing a special type of war automobile intended for the hunting of balloons and aeroplanes, which has been brought out recently in Germany.

This is a half-armored car fitted with a twenty horse-power cylinder benzine motor. Its drive is designed according to the system usual in connection with standard automobiles, the motor energy being transmitted through a friction clutch which is readily thrown out of gear to the speed-change gearing and thence through a cardan, to the rear wheels of the car.

The vehicle accommodates four passengers.

A rifle-gun designed on the Hotchkiss system is located in the interval between the front and back seats. This is free to rotate in a miniature gun-carriage round a bracket which in turn freely rotates round the pivot jack rigidly con-

ARMORED AUTO DESIGNED TO WARD OFF AERIAL ATTACKS.

nected to the chassis. The arrangement of this bracket allows the whole of the ground surrounding the vehicle to be covered by the rifle-gun without any motion of the vehicle itself.

A NEW TYPE OF GASOLINE WELL DRILL.

GASOLINE MACHINE DRILLS WELLS

WHILE steam is the well recognized ideal power for drilling purposes, there are many localities where fuel and water are so scarce and expensive as to prohibit its use. In many such places the slow and uncertain stop-motion horsepower drill has been resorted to; or, if gasoline engines are attempted they are applied to some sort of treadle-motion machine which allows the drill to take a time-killing rest between strokes.

A device has been perfected, which, it is believed, fills every requirement, and which has been applied to a new type of gasoline driven drilling machine. It consists of a combination friction driving disk and fly wheel on motor and a driven wheel on a transverse transmission shaft. On this shaft at one end is placed the pulley which drives the drilling mechanism by a belt and on the other end of the shaft is placed the trac-

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tion driving gear. This transverse shaft rotates in large slidable, hardened steel ball bearings, arranged to engage or disengage the driven wheel with the friction driving disk. The driven wheel is arranged to slide entirely across the face of the driving disk and in that way the speed graduation from "zero" to "high speed" or "reverse" is obtained; i. e., in sliding this driving wheel from the center toward the periphery to the right, gives all speeds from "zero" to "high speed" ahead, and from the center to the periphery, to the left, gives the graduated increasing speed backward.

The position of the driven wheel, which gives the graduated speeds in either direction, and its frictional contact are instantly controlled by a lever and hand wheel at each end of machine, and these manipulations can be accomplished in less time than the similar operation of the steam machine.

In operation the motor runs constantly in one direction at a pre-determined and governed speed—which may be, at will, anywhere between 250 to 500 revolutions per minute—and at such speed it will carry any load placed upon it to full load, just as required.

TYPE OF TRACTOR TO BE USED BY GERMANS IN AFRICA.

MILITARY LOAD TRAINS FOR GERMAN EAST AFRICA

THE illustrations show a tractor and trailer for use with a load train recently constructed by a German manufacturing company for use in connection with the construction of a railway between Morogoro and Tabora in German East Africa. The tractor is of a special type, for the construction of which the German War Department has recently granted a subsidy. It is built for use in tropical countries. The cars are equipped with an additional radiator connected through two special water reservoirs to the front cooler.

THE TRAILER AS FREIGHT CARRIER.

The cars are propelled by motors of thirty-six horse-power on the brake and are equipped with benzole carbureters.

The brakes comprise one gearing-brake, two differential brakes and two double-wedge brakes, acting directly on the rear wheels.

The chassis is made of compressed steel-sheets and the wheels are made of cast-steel and fitted with rubber tires. The fuel reservoirs suffice for a journey of about 150 miles.

The capacity of the motor cars is five tons and their loading length 3.6 meters. The trailer is able to carry a load of four tons up a gradient of eight per cent and a useful load of two tons up a gradient of twelve per cent.

The speed on dry and firm level roads is sixteen kilometers as a maximum, with 800 revolutions per minute.

In designing the cars belonging to this type of load train, a special point has been made of reducing the wear and tear to a minimum, all moving parts running in carefully lubricated hardened steel boxes and hardened bolts. All the different parts of the cars are readily accessible, exchangeable and interchangeable.

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The New Doctrine

"Do YOU believe in the literal idea of future punishment?"

"Not for myself," answered Mr. Sirius Barker. "But I favor it for a lot of people I know."—*Washington Star.*

His Charity

CLOSEFIST—"No, sir; I respond only to the appeals of the deserving poor."

OPENHAND—"Who are the deserving poor?"

CLOSEFIST—"Those who never ask for assistance."—*Tit-Bits.*

Couldn't Understand Plain English

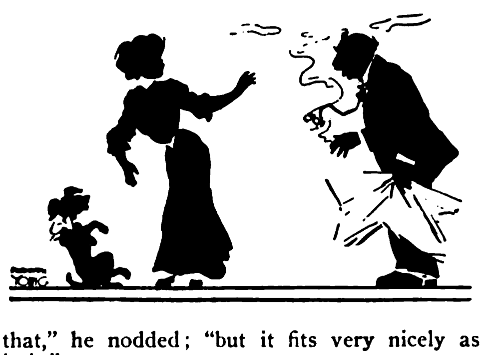
BY the extraordinary contortions of her neck, he concluded that she was trying to get a glimpse of the back of her new blouse; by the tense line and scintillating flash about her lips he concluded that her mouth was full of pins.

"Umph—goof — suff — wuff—sh—ffspog?" she asked.

"Quite so, my dear," he agreed. "It looks very nice."

"Ouff — wuff — so — gs — ph—mf—ugh—ight?" was her next remark.

"Perhaps it would look better if you did



that," he nodded; "but it fits very nicely as it is."

She gasped and emptied the pins into her hands.

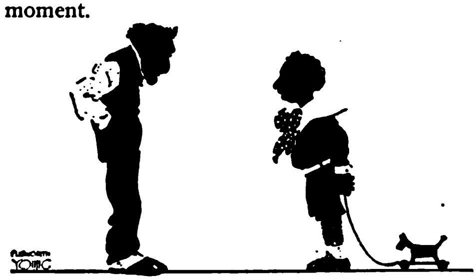
"I've asked you twice to raise the blinds so that I can get more light, James," she exclaimed. "Can't you understand plain English?"—*Chicago Record-Herald.*

Almost as Good

LITTLE Ikey came up to his father with a very solemn face.

"Is it true, father," he asked, "that marriage is a failure?"

His father surveyed him thoughtfully for a moment.



"Well, Ikey," he finally replied, "if you get a rich wife it's almost as good as a failure."—*Lippincott's.*

He'd Done It

"HAVE gooseberries any legs, muvver?"

"Why, no, of course not, dearie."

A deeper shade fell athwart dearie's face as he raised his glance to her.

"Then, muvver, I've swallowed a caterpillar!"—*Today's Magazine.*

Great Magnifiers

HE—"These glasses give me a very intellectual appearance, don't you think?"

SHE—"Yes. Aren't they powerful."—*Boston Transcript.*

Not What It Seemed

A RATHER impulsive young Mr.
Took a girl to the game and there Kr.
When they asked "Is it fun?"
He replied, "No, it's none,
It's a duty one owes to one's Sr."—*Harvard Lampoon.*

An Unreliable Dog

"COME right on in, Sambo," the farmer called out. "He won't hurt you. You know a barking dog never bites."

"Sure, boss, ah knows dat," replied the cautious colored man, "but ah don't know how soon he's going to stop barkin'."—*Success.*

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A Sad Fact

Two MEN met on the street. They hadn't seen each other for months. One of them had a wife who occasionally figured in the society columns. After they had exchanged views on things in general, the other man asked him—"Is your wife entertaining this spring?" "Not very," said he.—*Everybody's Magazine.*

He Called the Bluff

MOTHER—"Just run upstairs, Tommy, and fetch baby's nightgown."

TOMMY—"Don't want to."

MOTHER—"Oh, well, if you're going to be unkind to your new little sister, she'll put on her wings and fly back again to heaven."

TOMMY—"Then let her put on her wings and fetch her nightgown."

Hadn't Counted on That

"BUT, Alfred," she said, "how can we live on $14 a week?"

"That means, I suppose," faltered the young man, "that you expect to throw up that $10 a week job of yours after we are married!"—*Chicago Tribune.*

The Simple Life

PASSER-BY—"See here, you are the man who struck me for a dime three days ago."

BEGGAR—"Yes, sir; but do me best, I can't keep me expenses any lower than 3⅓ cents a day."—*Baltimore American.*

'Twould Hardly Do

A PHILADELPHIA woman, whose given name is Mary, as is also the name of her daughter, had recently engaged a domestic when, to her embarrassment, she discovered that the servant's name, too, was Mary.

Whereupon there ensued a struggle to induce the applicant to relinquish her idea that she must be addressed by her Christian name. For some time she was rigidly uncompromising.

"Under the circumstances," said the lady of the house, "there is nothing to do but to follow the English custom and call you by your last name. By the way, what is it?"

"Well, mum," answered the girl, dubiously, "it's 'Darling.'"—*Harper's Weekly.*

Foiled

THE CONSTABLE—"Now, gen'l'men, we've traced these here cloos—the futprints o' the ho'se an' the fut-prints o' the man to this stump; from here on thar's only the fut-prints o' the hoss. Now, the question is—Wot's become o' the man?"—*Life.*

When Theory Didn't Work

THE new teacher surveyed her wriggling, restless charges with some dismay. But, true to her oft-studied book of instructions as to the best manner of implanting knowledge in the young mind, she began:

"Now, children, what is it that a cat is covered with? Is it fur? Is it hair? Is it feathers? Is it wool? Johnny Halloran, you may answer."

Johnny, seven, soiled and starved-looking, arising in a state of mingled contempt and perplexity, replied:

"Say, honest, is youse kiddin' or ain't youse never seen a cat?"—*Today's Magazine.*

A Request

A PARENT who evidently disapproved of corporal punishment wrote the teacher:

"Dear Miss: Don't hit our Johnnie. We never do it at home except in self-defense."—*Sacred Heart Review.*

Crickets

SILENCE had fallen between them in the dusk of the porch; through the warm air of late summer came the strident notes of the katydids and the voices of the choir at practice up at the church.

"They are real musical tonight," said he, thinking of the choir.

"Yes, 'tis said they do it with their hind legs," replied she, thinking of the crickets.—*Today's Magazine.*

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SCIENCE AND INVENTION

CLOCK DOES TEACHER'S WORK

ASTRONOMICAL clocks are fairly common nowadays but one lately shown to King Edward in London, and examined by him with the greatest interest, has certain points not to be found in others already on the market. This is the chronosphere—or, as its inventor, Mr. J. Haddon Overton, of Woodstock, prefers to call it, the Empire clock; and its great merit is that it performs with absolute accuracy and precision the duties usually discharged by the teacher in giving lessons on the earth's daily motion, latitude and longitude and geography generally.

Clock Which Offers All Sorts of Geographical Information.

At first glance the chronosphere might be mistaken for an ordinary school globe, but it differs therefrom in many important essentials. It gives, for example, the correct time all over the world, and it demonstrates the actual rotation of the earth, on its axis, in twenty-four hours, and the actual speed of the earth three inches (smaller size) and four inches (larger size) from its center. It also gives at a glance the difference in the times between all places on the earth's surface, and the correct mean time at any town or place in the Eastern or Western hemisphere, and it further enables teachers and lecturers in elementary, evening, secondary and public schools and colleges to demonstrate in the concrete the daily rotation of the earth from west to east; the difference in time caused by this rotation and the exact relative position of every place on the world and its exact position at any time in relation to the light of the sun, i. e., day or night. By use of the sun attachment the actual height of the sun in degrees above the horizon from December to June and June to December can be clearly demonstrated, thus showing the cause of the varying lengths of day and night. The axis is inclined at any angle of 23½ degrees, and the revolution is in the earth's own direction. The motive power is in the base of the stand upon which the globe is mounted and the apparatus requires winding only once a week. The chronosphere, in its pres-

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TYING HIS HORSE TO A HOLE IN THE GROUND.

ent form, represents the outcome of fourteen years' close study and experiment.

TYING A HORSE TO A HOLE IN THE GROUND

THROUGHOUT the desert section of the southwestern part of the United States, where there is neither bush, tree nor stone, the range riders have evolved a unique scheme for tying their horses.

Digging an L-shaped hole in the firm soil of the range, the cowboy ties a large knot in the free end of his bridle, shoves the knot far down to the end of the hole, tamps the earth in, and no average horse can pull himself free without breaking the bridle.

Most of the range horses will stand for an indefinite time, if their rider merely throws the bridle over the animal's head, so that one end of it trails on the ground. Whether the horse thinks he is tied, and does not try to break away because of previous lessons learned when tied to the snubbing post in the breaking corral, or reasons it is his business to stand when his master throws the bridle over his head, is up to Burroughs and Thompson-Seton; it has never worried the cowboys. A horse that will run like a deer whenever his master leaps from his back without throwing the bridle over his head, will stand like a lamb, once this act has been performed.

BIRD THAT KILLS SNAKES

CALIFORNIA has in its game laws a protective clause for a bird which is neither a songster, nor a game bird. The only reason this bird, a member of the cuckoo family, is protected, is that it kills snakes.

It looks like a small pheasant, and has more names than any other bird known to ornithologists. To the scientific sharp it is Geococcyx californianus, but it is most widely known as the roadrunner. A few of its other names are Chapparal cock, snake killer, cactus hen, paisano—the latter being the common name given to it by the Mexicans of the Southwest—lizard bird, ground cuckoo and fool bird.

In old stories of Southern California, the roadrunner, as it is most commonly called, was credited with killing rattle and other snakes by building a fence of sharp-spined cactus leaves around the reptile and gradually crowding the wall of thorns closer and closer until the snake's body was penetrated in several places by the cactus needles.

As a matter of fact, the roadrunner, whose wings are so short that it rarely uses them for flying, and then only from an elevation, leaps upon the back of the reptile it wishes to kill, drives its sharp beak into the creature's brain, killing it almost instantly, and then carries it away

CALIFORNIA ROADRUNNER, WHICH MAKES A SPECIALTY OF DESTROYING SNAKES.

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A MUSHROOM OF WEIRD GROWTH.

to some secluded part of the brush to eat at its leisure.

When a harmless snake and a poisonous one, say a rattler, are put in the same cage with a roadrunner, the bird always kills the poisonous snake first. This experiment has been tried in Southern California a number of times, always with the same result.

MUSHROOM OF STRANGE GROWTH

THIS mushroom, which weighs over nine ounces and is thirteen and one-half inches across, has a stem twenty-one inches long and three and one-half inches thick.

It was found a short time ago under flooring at Olympia, Washington.

NEW INSTRUMENT TO AID DRAFTSMEN

THERE has recently been placed on sale a vertically arranged T-square, guided at the top of the drawing board and having a protractor with scales sliding vertically thereon. The head of the T-square is provided with a set of four rollers guided upon a straight steel track which is fastened to the top of the drawing board. One pair of these rollers is beveled, and runs on ball bearings so arranged that the weight of the head holds it upon the track with absolutely no lost motion, making possible a very free and sensitive movement. The head also carries a spring balanced drum to which is attached a cord which connects with the vertically sliding protractor and acts to hold the latter to the blade.

Pivoted to the sliding protractor is a forked arm to which interchangeable scales are attached. This arm is provided with a worm which engages notches cut in the rim of the protractor and which can be quickly pressed out of engagement therewith. These notches are spaced three degrees apart, thereby making possible an instantaneous setting of the instrument to any multiple of three degrees, which includes all the most commonly used angles.

In addition to the obvious advantages of the instrument for the horizontal board, it is more necessary for the vertical. It combines T-square, protractor, scales and triangle into one self contained whole, depending from the top of the board, while with the old arrangement one of these articles is usually on

A NEW DRAFTING INSTRUMENT UNUSUAL IN FORM AND USE.

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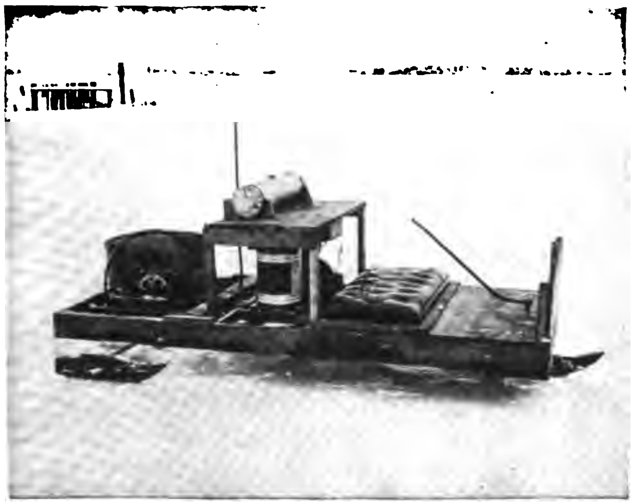

ICE-AUTO IMPROVISED BY INGENIOUS YOUNG MEN.

the floor, and the rest scattered along the parallel rule.

It eliminates the use of the parallel rule, with its inaccuracies and troubles, and its speed and accuracy in making projections alone will pay for its installation.

IMPROVISED ICE AUTOMOBILE

TWO Marine City, Michigan, young men, John Milot and John Beebe, improvised a curious ice motor the past winter. They removed from a motor boat the three horse-power gasoline engine and fitted it to a frame. This frame is eight feet long and three feet wide, with runners five feet apart. With a twenty-eight inch drive wheel the novel vehicle made a very high rate of speed.

HOUSE OF STONE CHIPS

THE house of many spalls, or stone chips, shown in the accompanying picture is not to be matched in the world, and the builder of it has accomplished what veteran stone masons told him could not be done,—building the lower story entirely of spalls anchored in a foundation of Portland cement, reinforced with steel rods. This unique house is the residence of F. H. Venn, of Memphis, Tenn., who built it himself from a vast collection of spalls which he has accumulated in his marble and granite business. There are chips in this house from nearly every State in the Union, and from many foreign countries. They have come from the marble quarries of Italy and Greece; from the sandstone beds of Norway; from New Hampshire's granite hills; and from the porphyry beds of Mexico; Australia has contributed and Ceylon added to their number and variety, and Egypt given from the quarries whence the pyramids came.

The stones range in weight from a few ounces to 750 pounds, and cover an infinite variety of rocks, granites and marbles. Gold-bearing quartz, in homeopathic sizes, copper ores, iron ores, silver ores, onyx and sardonyx, jasper, flint, limestone, basalt, and rubble, are all in these walls.

One of the greatest difficulties which Mr. Venn had to overcome was to so balance the spalls while the cement was wet, that they would remain in position till the cement could harden. This difficulty will be the more apparent when it

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HOUSE BUILT OF CHIPS COLLECTED FROM NEARLY EVERY STATE IN THE UNION.

is stated that the spalls project from a half inch to over a foot. The feat was accomplished, however, by a scheme of anchors which were allowed to remain in the wall after they had served their purpose and thereby gave it additional strength. All the anchors are hidden from the eye. The lintel over the door is eight and a half feet long, and is composed of thirty-six pieces. It is supported at the ends only, and weighs over two hundred pounds. The arched balustrade which weighs two tons, hangs from the columns and is not supported from the floor.

The play of colors seaming through the irregular surface, and the variation in size and shape of the fifty odd thousand spalls, give an effect that is odd beyond description, and no visitor ever passes the house of many spalls without stopping to wonder and admire. It is a peculiar combination of the unique and picturesque without being freakish and without losing anything from an architectural point of view as a neat, dignified house.

WOMAN INVENTS FIRST STOCKING DARNER

TO the inventive genius of a woman, Mrs. Agnes G. Maynard of Denver, Colo., now of Chicago, is due one of the greatest labor saving devices ever offered to housewives, namely, the stocking darner. Mrs. Maynard was the first person to ever put on the market a darner that would do easily and well the work of darning stockings by means of a sewing machine—any ordinary two-thread machine may be used—and although this stocking darner is yet practically young it has had some followers but none that seems to work as well or is as practical as this—the first one.

Mrs. Maynard conceived the idea of trying to darn her stockings on the machine as she did her towels and table linen. This she found impossible to do as she could in no way get the toe or heel of the stocking under the presser foot in such a way as to allow of darning. She then set about a way of doing so but nothing seemed to work until one day when at work cutting biscuits with a tin cutter the idea suddenly came. She, then, by bits of pasteboard and soft tin made her working model and so successful was it that she soon patented it.

This darner is a small, oval-shaped band of steel, having tiny prongs on one edge which hold the stocking taut, and on the other, L shaped arms, which swing inward when adjusting the darner in the stocking, and outward to hold down that part of the stocking rolled around the darner. There is an opening in one side allowing the machine needle to pass through.

Darner Holding Stocking Ready to Slip Under Presser Foot.

This darner can be used on any two-thread machine—no matter what make—by simply removing the presser foot, which allows the operator to sew both backward and forward, thus giving the necessary speed for darning. The needle is pushed across the hole in the stocking until a close lattice work is woven and when the hole is mended it presents a smooth surface which far surpasses hand work and is, beside, done in less than half the time that is required by the hand method, which this invention should speedily displace.

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ALMOST IN SIGHT OF THE SOUTH POLE

By HENRY GARDNER

TRAVELING 170 miles over snow and ice, in a temperature that reached as low as 40 degrees below zero, and with a motor-sledge as aid in crossing the frozen deserts and the glaciers, Lieut. E. H. Shackleton, of the British navy, and a party of hardy companions planted the Union Jack at the magnetic south pole on January 16 last. On January 9, Lieut. Shackleton himself pentrated the frozen south to within 111 miles of the geographical south pole, and so established a record, 340 miles better—or nearer the goal, than the Scott expedition of December, 1902.

The journey consumed 126 days and was full of the hardships and dangers made familiar through the accounts of northern explorers. The explorers speak of the temperature encountered as mild, compared with what was expected, but storms and the difficulties of transporting supplies across broken country in sixty degrees of frost made handicaps enough to put plenty of thrill into the story they have to tell. The results secured are considered very valuable by scientists, however, and the expedition is a great success in other ways than in the making of the record.

In THE TECHNICAL WORLD MAGAZINE for December, 1907, appeared an account of Lieut. Shackleton's start upon the journey which has been so successfully completed. The novelty of the enterprise was described then. The motor sledge, by which the passengers and supplies were to be transported, where ponies and dogs could not go, was expected to help greatly, and from

MOTOR-SLED USED BY THE SHACKLETON EXPEDITION IN ITS DASH FOR THE SOUTH POLE.

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LIEUTENANT E. H. SHACKLETON, THE BRITISH NAVAL OFFICER, AS HE APPEARED BOARDING HIS VESSEL OVER A YEAR AGO ON HIS START FOR THE SOUTH POLAR SEAS.

what the explorers report, it did its work well. Dogs and horses were used, but the sledge propelled by its engine, carried the burdens across many weary icy miles, took supplies to the depots from which the sledge-parties were fed, and was undoubtedly of material usefulness. A photograph of the machine is reproduced with others herewith.

Important geological collections were made by the party, several mountain ranges were discovered and scientific data were compiled which will be valuable in the final push for the geographical pole which will undoubtedly soon follow. The party made a voyage by ship from New Zealand south into the unexplored Antarctic region on the ship *Nimrod,* which was provided specially for them. They landed at the point where Captain Scott ended his voyage in 1902. Lieut. Shackleton had been so far before, as he was a member of Captain Scott's expedition. Here the explorers split their party into two. Lieut. Shackleton, with Lieut. J. B. Adams, meteorologist, G. Marshall, in charge of ponies, and others, made the

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journey south toward the geographical pole. J. K. Davis, first mate, and Forbes Mackay, assistant surgeon, led another party more to the northward for the magnetic pole. Living on canned supplies with pony meat to eke them out at times, the two parties made their dashes, each for its special object. They utilized the depots and food supplies established by the former party, and were guided by the experiences of previous explorers to some degree, but most of the effort they made to penetrate to the actual pole, was in the line of entirely new discovery. A portion of Lieut. Shackleton's own narrative, as given in dispatches to London papers, will give the best idea of what was encountered.

"We left Cape Royd October 29, 1908," he says in speaking of his own party. "We left Hutpoint November 3, with ninety-one days' provisions. We were held up at White Island on November 5, and staid there four days because of a blizzard. Our supporting party returned November 7.

"Owing to the bad light among the ice crevasses, Adams' pony nearly was lost. We reached November 13 the depot laid out in September in latitude 79 degrees 36 minutes, longitude 168 degrees east. We took on the provisions there and commenced reducing our daily rations. We traveled south along meridian 168 degrees over a varying surface of high ridges and mounds of snow, alternating with soft snow. The ponies often sank to their bellies. On November 26 we reached the Discovery expedition's southernmost latitude. The surface now was extremely soft, with large undulations. The ponies were attacked with snow blindness. On November 28 the pony, Crisi, was shot. We made a depot in latitude 82.45; longitude 170. Pony Quan was shot on November 30.

"Steering south southeast, we now were approaching a high range of new mountains trending to the southeast. We found on December 2 a barrier that, influenced by great pressure and ridges of snow and ice, had turned into land. We discovered a glacier 120 miles long and approximately forty miles wide, running in a south southwesterly direction.

"We started on December 5 to ascend the glacier at an altitude of 83.33, longitude 172. The glacier was badly

How the Ship's Compass Was Arranged so as to Be Free from All Incidental Magnetic Influences.

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THE *NIMROD*, WITH WHICH LIEUTENANT SHACKLETON NEARLY MADE THE SOUTH POLE.

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crevassed as a result of the huge pressure. The surface on December 6 was so crevassed that it took a whole day to fight our way 600 yards.

"On December 7 the pony, Socks, breaking through a snow lid, disappeared in a crevasse of unknown depth. The singletree snapping, we saved Wild and the sledge, which was damaged. The party was now hauling a weight of 250 pounds per man.

"The clouds disappearing on December 8 we discovered new mountain ranges trending south southwest. Moving up the glacier over the treacherous snow covering the crevasses, we frequently fell through, but were saved by our harness and were pulled out with an Alpine rope. A second sledge was badly damaged by the knife edged crevasses.

"Similar conditions obtained on our way up the glacier from December 18, when we reached an altitude of 6,800 feet. In latitude 85.10 we made a depot and left everything there but our food, instruments, and camp equipment, and reduced our rations to twenty ounces per man daily.

"We reached on December 26 a plateau after crossing ice falls at an altitude of 9,000 feet, thence rising gradually in long ridges to 10,500 feet. Finding the party weakening from the effects of a shortage of food and the rarefied air and cold, I decided to risk making a depot on a plateau.

"We proceeded on January 4 with one tent, utilizing the poles of the second tent for guiding marks for our return. For sixty hours during January 7, 8 and 9 a blizzard raged with 72 degrees of frost and the wind blowing seventy miles an hour. It was impossible to move. Members of the party were frequently frostbitten in their sleeping bags. We left camp on January 9 and reached latitude 88:23, longitude 162. This is the most southerly point ever reached. Here we hoisted the Union Jack presented to us by the queen. No mountains were visible.

"We saw a plain stretching to the south. We returned to pick up our depot on the plateau, guided by our outward tracks, for the flags attached to the tentpoles had been blown away. The less violent blizzards blowing on our backs helped us to travel from twenty to twenty-nine miles daily."

The return journey was made under greater suffering than the outer march. The men suffered with dysentery from eating pony meat, with which they were forced to help out their other provisions. They barely made points where provisions had been cached, several times, when

Map of the Southern Seas, Showing the Route of the *Nimrod* Expedition.

their supplies were used up. The storms also were very heavy. As Lieut. Shackleton goes on to say:—

"The blizzards continued, with fifty degrees of frost. We discarded everything except our camp outfit and geological specimens. Helped by a southerly blizzard, which was accompanied by 67 degrees of frost, we reached, on February 23, the depot at Minna Bluff. Here we received news from our ship. We made a forced march of twenty-four miles February 26. On February 27 Marshall was unable to march. I left him in charge of Adams while Wild and I made a forced march to the ship for relief. I returned March 1 with a relief party and all reached the ship at Hut Point March 4 in a blizzard.

"The total distance of the journey, including relays, was 170 statute miles.

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The time occupied was 126 days. The main result is a good geological collection. We found coal mixtures in limestone. We also made a complete meteorological record. We discovered eight distinct mountain ranges and over 100 mountains. We surveyed and photographed many glaciers and found signs of former greater glaciation.

"The geographical south pole doubtless is situated on a plateau from 10,000 to 11,000 feet above sea level. The altitudes of the new mountains ranged from 3,000 to 12,000 feet, approximately. Violent blizzards in latitude 88 degrees show that if a 'polar calm' exists it must be in a small area or not coincident with the geographic pole."

TO CONQUER OIL TANK FIRES

By M. M. MAYNARD

OF all the states that have suffered severely through the medium of the oil tank fire, Texas has without doubt, been one of the greatest of sufferers, and therefore it is not surprising that to a native of this southern state, Professor Spawn, falls the honor of having invented an apparatus that will reduce loss from such a source immensely. At the same time the originator of this new extinguisher has given to the oil industry an invention that will prove to be of priceless value.

At a demonstration held at Houston, Texas, an eight foot tank of oil was actually subjugated before the eyes of well known oil experts in the extraordinary period of less than two minutes, the actual time being one minute and forty seconds. In a previous demonstration of the extinguisher's capacity the fire in the tank was controlled in forty seconds, and an even greater record of twenty seconds has been made. These records no doubt would have been established in the demonstration before the experts of the oil companies, had not some of the holes in the pipe through which the gas is spread become clogged, thus permitting the oil under them to burn for a longer

EXPERIMENTAL OIL FIRE EXTINGUISHED IN TWENTY SECONDS AT A COST OF THIRTY-FIVE CENTS.

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THE APPLIANCE USED IN EXTINGUISHING OIL FIRES.

period than would have been necessary had the apparatus been working as usual.

Professor Spawn's invention provides for running a small pipe around the tank, almost at its top. This small pipe is perforated equidistantly its entire length. In this manner the gas is distributed freely over the contents of the tank. For installation of this system in the oil fields, however, the gas used to quench the fire, is intended to be made at a stationary plant and from there piped to the different oil tanks, according to their location in the field. In this way it is able to reach a greater number of tanks more rapidly, and at the same time the entire supply could be forced into a single tank for a speedy attack, as the occasion demands.

In the central tank referred to there are two separate receptacles holding the two chemicals. The exact nature of these chemicals the writer is unable to state, as the Professor does not divulge this information. However, he is authority for the statement that it is absolutely impossible for fire to exist where there is present from 35 to 40 per cent of this gas.

In the demonstration for the benefit of the oil officials and experts, the chemicals were contained in two separate receptacles. The fire was allowed to reach the proportions shown in the illustration, and while the blaze was gaining headway, Professor Spawn was busy mixing his chemicals in the halves of an ordinary barrel. When the flames were at their worst, the two chemicals were thoroughly mixed by means of the two small hand pumps, shown in the second illustration. As the resultant mixture played upon the burning oil in the tank, the result was nothing short of marvelous. Instantly there was a sizzling, frying sound, and the flames that appeared so angry but a minute before, dropped gradually lower and lower, and in one minute and forty seconds the fire in the oil tank was no more.

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EXTRAORDINARY "ARROWHEAD" ON THE FACE OF CLIFF NEAR SAN BERNARDINO, CAL.

ARROWHEAD VISIBLE AT THIRTY MILES

By R. A. FAWCETT

BLAZED high upon the side of a huge mountain range a mile above the sea, there is in existence in Southern California today a phenomenon which has for years baffled the scientists. In the accompanying cut is shown this mystic symbol, a gigantic and almost perfect arrowhead, visible at a distance of thirty miles, the marvel of all those travelers who have passed through the city of San Bernardino on any of the three transcontinental lines entering the state.

It looks so huge that you will hardly be surprised to learn that it is a quarter of a mile long—1,375 feet—by nearly a furlong—550 feet—wide, and covers seven and a half acres. Its "blaze" is produced by an outcrop of white quartz and light grey granite covered with only the thinnest of light sage, California poppy and other light green vegetation, darker earth and dark green chapperal of the mountain side surrounding it.

Clear as it is at a distance, on the spot the outlines are startlingly distinct. The shanks and barbs of the arrowhead are bordered by thick chapperal of chanse, live-oak, greasewood, and poison sumac rising abruptly as a hedge five to seven feet high.

On the blistered mark itself nothing will grow except pale, palsied-looking sage, thin and straggled like an old man's beard. At the very foot of this wonderful emblem bedded in the Sierra Madre mountain range, are the celebrated "Arrowhead Hot Springs," where the hottest curative waters in the world gush forth, the temperature being 192 degrees, or about 30 degrees hotter than the water of the great "Sprudel" at Carlsbad, Bohemia.

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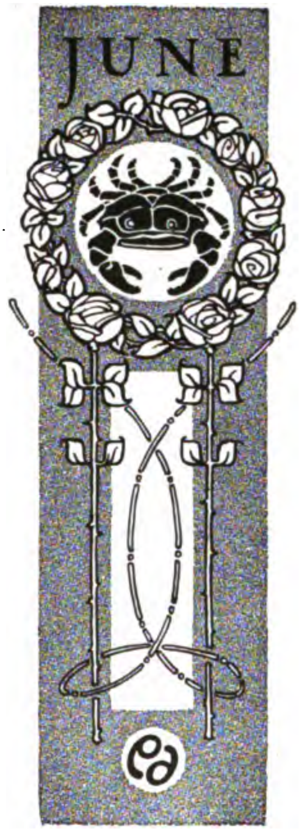

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DR. JOSEPH HOLMES, INVESTIGATOR OF MINE DISASTERS.

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For Article see Page 379

THE TECHNICAL WORLD MAGAZINE

Volume XI JUNE, 1909 No. 4

SLAUGHTER OF THE INNOCENTS

By DR. ALVIN DAVISON

Professor of Biology in Lafayette College, Pennsylvania.

THE state of Pennsylvania spends over $30,000,000 annually to educate its children, thousands of whom will never be able to render it any service because of slight but neglected disorders in childhood, which cause early death, or dwarf the physical vigor. It would be poor policy for a man to secure an automobile at the cost of $5,000, and then permit it to deteriorate to the value of $1,000 in a few weeks, because it was not properly cared for. It is an equally unwise policy to spend money in educating a child whose physical life is early wrecked through neglect during school days.

The older countries have recognized the value of medical inspection and made use of it for many years. It has been in operation in Paris for half a century, and Havre, Brussels, Dresden, and most of the cities and towns in Sweden have had authorized medical inspection in the schools for more than a quarter of a century. The thoroughness with which it has been carried on in Sweden and Japan during the last ten years probably accounts in part for the low death rate in the former country and the general physical vigor in the latter Empire. Regular medical inspection began in this country in New York City in 1892, in Boston in 1894, in Chicago in 1896, and in Philadelphia in 1897.

DR. ALVIN DAVISON.

Within the last decade medical inspection has spread rapidly over the United States, so that at present the school children are under its influence in about 100 cities and 300 towns. The only cities in Pennsylvania which have tried medical inspection longer than six months are Philadelphia, Harrisburg, Hazelton, West Chester, Reading, Norristown, and Lancaster. Four states, Connecticut, New Jersey, Vermont, and Massachusetts, recognizing the benefits of health supervision, have enacted laws requiring or permitting the physical examination of school children in various ways. The 1906 law of Massachusetts requires the inspection of the school children in every town and city for the detection of contagious diseases, and also for the discovery of physical defects, whether of the eye, ear, or other parts of the body. The fact that no city or town having once begun regular medical inspection has ever

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A MOUTH-BREATHER—A VICTIM OF ADENOIDS.
Breathing through the mouth invites disease. Nearly a million school children are thus afflicted.

in the early stage of the disease, which only medical inspection can detect.

How widespread may be the infection resulting from the presence of one source of contagion is forcibly demonstrated by an occurrence in a school at

BOY TEN YEARS OF AGE WITH ADENOIDS AND GREATLY ENLARGED TONSILS.
He is two years behind his grade in school. He is, of course, a mouth-breather.

relinquished it, is a strong argument in its favor.

That there is a real and serious need for health inspection in the schools, is clearly evident from the facts set forth by numerous reliable investigators.

More than 100,000 children of school age are annually laid prostrate by the three preventable diseases of diphtheria, tuberculosis and scarlet fever, and 20,000 of these illnesses terminate fatally. In diphtheria and scarlet fever, the infection generally passes from pupil to pupil

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Photograph of the Tonsils Removed from Ten-Year-Old Boy in the Previous Picture.
Note the crypts—depressions—through which bacteria readily enter and infect the glands in the neck and lungs.

Millgrove, Ohio, where a boy with incipient measles infected every member of the school, including the teacher, so that they all fell sick within ten days. If discovered early, the sick are not only prevented from infecting the well, but are, in most cases, easily cured. In one year about 700 pupils with diphtheria, scarlet fever and tuberculosis were found attending the schools of Massachusetts. During the same period several thousand children with other contagious diseases such as measles, mumps, grippe, and syphilis were excluded from these schools in the interest of health. There can be no doubt that the early discovery of these ailments prevented them from infecting hundreds of other children. Over 15,000 cases of contagious eye diseases were found in the New York City schools in one year, and 65,000 other children were excluded for various transmissible ailments ranging from diphtheria to whooping-cough. In Philadelphia about 10,000 of the school attendants during the year are excluded at some time, because of diseases which menace the health of their associates.

A study of the cases of scarlet fever and diphtheria occurring during vacation periods and during the school months, shows that under present conditions the schools are largely responsible for the spread of these diseases. The number of cases is usually doubled within a few weeks after the opening of the schools in September, as may be seen by the chart on page 349.

The detection and exclusion of communicable diseases is but one of the two important results secured by medical inspection. The greatest need for this work is found in the fact that a large per cent of school children suffer from some physical defect, which in many cases, can be easily remedied, but which often lessens by a fourth and sometimes a third, the real benefits to be derived from the instruction.

The report of Dr. Rebuck of Harrisburg shows that out of 295 pupils examined, 126 were defective in hearing or vision. Among nearly 100,000 children in New York City, about one-third were found to have such defective eye sight as to require glasses. In Philadelphia 60 per cent of the children examined showed marked eye strain or defective vision and 354 pupils were discovered who could not read ordinary writing on the blackboard even at the distance of a few feet, and could only with difficulty make out the print in their books. In Massachusetts, outside of Boston, 20 per cent of the pupils were found defective in vision. In Camden, N. J., 27 per cent were defective in vision. In London, 10 per cent of school children are reported as suffering from serious visual defects. The combined reports

Ringworm of the Scalp Caused by the Growth of a Mold in the Skin.
This persistent malady is transferred from one school child to another.

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of numerous observers show that from 10 to 20 per cent of school children have such abnormal sight, that they are not only wasting an appreciable portion of their time in school, but, in some instances, are wrecking their health in seeking the education which the state offers them.

The number of children with defective hearing or diseased ears in our schools is large. Massachusetts reported 27,000 pupils with defective hearing in the year 1907. Investigations in fifteen different cities lead to the estimate that nearly percentage of dull children are so because the eye, or the ear, each one of the chief avenues for the reception of knowledge, is partially blocked.

Defects in the senses may and often do exert a baneful influence throughout life but they are not so likely to weaken the physical vigor and invite disease as defects in the teeth.

The reason assigned for the fact that we are a nation of dyspeptics, is the neglect of the teeth of children during school years, and the inability to recover

ONE OF THE HALF-MILLION INTELLECTUAL MILLS OF OUR COUNTRY, WHERE THE MIND IS OFTEN EXAMINED AND TENDED WITH CARE, WHILE THE UNEXAMINED AND NEGLECTED BODY TOO OFTEN BECOMES A PARTIAL OR COMPLETE WRECK.

50,000 children in Pennsylvania are unable to reap the full advantage of instruction given, because of defective hearing. The fact that there were discovered among the Philadelphia school children 750 cases of middle-ear disease in 1907 indicates that there are in this state 4,000 pupils suffering from a malady certain in some cases to cause deafness. The census report of 1900 shows that in this state there are about 3,000 persons in whom deafness has been caused by middle-ear disease. There is no longer any doubt that a considerable

the lost art of chewing. An examination of 79,000 children in the New York schools showed that 29,386 possessed one or more decayed teeth. In Strassburg, Germany, the first city in the world to adopt dental inspection, 97½ per cent of the school children were found to have diseased teeth. Eighty per cent of the children in Great Britain's industrial schools suffer from decayed teeth. In Germany, among 20,000 children between the ages of 6 and 16, 19,000 of them were found to have caries in a marked degree.

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OF THIS GROUP OF CHILDREN IN AN OHIO SCHOOL, FORTY-FIVE HAVE DECAYED TEETH.
About one-third of the number own tooth-brushes, several use their mother's brush, or have one in common with a brother or sister.

Doctor Kerr, after the examination of hundreds of children, records that the dentition of the average school child is in a deplorable condition. One child examined had eleven decaying stumps, one fourteen, and another seventeen. One girl had but two teeth and one boy possessed not a single sound tooth. Toothache? Yes, they suffered the torture of Prometheus bound. In the face of these conditions the Christian scientist and the stoic are the only ones who can put up an honest argument against medical inspection. The one says there is no matter there to ache, and the other believing that suffering is a virtue, says there is matter but it doesn't matter if there is. Zederbaum says, of 500 children examined in Michigan, 450 of them needed dental attention. Judging from these figures, it is evident that at least half of the school children of this state have decayed teeth; which, in a large majority of cases, will cause more or less ill health, and reduce greatly their value as future citizens.

Adenoid growths, enlarged tonsils and other throat troubles are frequently caused and always aggravated by rotting teeth which constantly give off poisons from the filth germs in their cavities. Headache, constipation, chorea or St. Vitus dance, and the milder nervous disorders, in many instances have their first

A PENNSYLVANIA SCHOOL IN WHICH THIRTY-THREE PER CENT OF THE CHILDREN HAVE DECAYED TEETH, INVITING DISEASE AND PREVENTING PROPER DIGESTION.

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cause in defective teeth. The researches of the last two years have definitely shown that carious teeth form an important factor in the cause of tuberculosis, both by weakening the system and producing inflamed mouth tissues through which the germs may readily enter. Perfect teeth demand perfect digestion. Perfect digestion demands perfect mastication. Perfect mastication demands perfect teeth.

Out of 23,000 men refused enlistment in the British army in one year, 5,000 were rejected because of decay or absence of one or more teeth. One thousand of the applicants for enrollment in the United States army for the fiscal year 1905-1906, were refused admission because of bad teeth. Dental caries, so detrimental to the health and future usefulness of the nation's living wealth, has become such a common factor as a health destroyer, that it has been well styled the "people's disease."

Still further evidence that the human machine in its early days needs careful inspection to insure its greatest future efficiency, is furnished by the investigations of Hertel, of Denmark, Key in Sweden, Crichton Brown, and Warner in Great Britain, Zahor in Prussia, and Nesterok in Russia. These men have shown that in their countries, the average morbidity for boys in school was 29 per cent, and for girls, 42 per cent. Dr. Johnson states that 75 per cent of the girls and 33 per cent of the boys who left high schools in one year in Cleveland, did so because ill health prevented them from keeping up with their studies. He reports that in five cities in the United States, 16,000 children between eight and fourteen years of age were taken out of school within one term because of ill health.

HEAD LOUSE. MUCH ENLARGED. TO SHOW ITS LOATHSOME AND DANGEROUS CHARACTER.
A common affliction of children improperly cared for.

Late investigations show that probably one-half of this ill health is due to abnormal conditions of the eye, ears, throats or teeth, which medical inspection could discover in time to prevent baneful results. These facts make it clear that there is a real need of medical inspection, if it can decrease the amount of sickness and death, and remedy physical defects to such an extent as to pay for the cost.

A study of conditions in Boston, Philadelphia, Cincinnati, Detroit and Montclair, shows that the cost for the necessary inspection to detect and exclude communicable diseases is about fifteen cents annually per pupil. The cost for the examination for physical defects is thirty-five cents per pupil. We spend about $30,000,000 in Pennsylvania for public schools, and the additional cost for medical inspection, basing the estimate upon one million pupils, would be only $500,000. If, then, $500,000 worth of health and human life can be preserved by medical inspection, it is the duty of educators to ask the legislature to enact laws compelling such inspection in every town and city of the commonwealth.

The time required for a child to finish the work of a given grade, is a fair criterion of mental deficiency. According to Doctor Newmayer, Superintendent Corman of Philadelphia reports in 1906, 13,830 pupils as having been between two and three years in one grade, and in 1907, more than 18,000 children in Philadelphia were reported as having been two years or longer in one grade. In New York City last year over 250,000 children failed of promotion in their grade and Supt. Maxwell claims that the root of the trouble is largely in physical defects, capable of being remedied in a great measure. Further studies and observations lead to the conclusion that about 10 per cent, or 100,000 children in this state are mentally deficient to such a degree as to require nine years of instruction to secure the education which the normal child gets in six years. The extra amount spent in the education of these mental defectives is then about $1,500,000. However, only about one-half of this mental deficiency is due to physical defects which medical inspection can remedy; and in only one-fourth of the cases can it remedy the defects completely. Therefore, the actual saving in instruction would probably be less than a quarter of a million dollars; but the increased value of perfect manhood and womanhood given to future citizens, is beyond computation.

Certain physical defects, in youth, remaining undiscovered and uncorrected, add a considerable number of disabled citizens to the asylums for the feeble

IMPETIGO. A CONTAGIOUS SKIN DISEASE CAUSED BY A MINUTE PARASITE PLANT.
Medical inspection has entirely banished this disease from some schools where it was formerly present throughout the year.

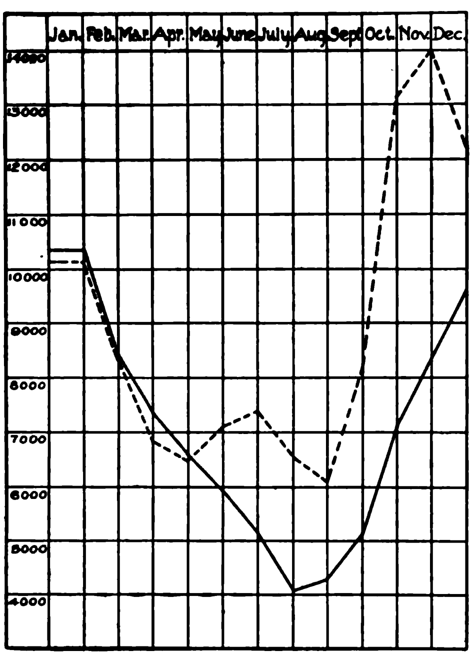

CHART COMPUTED FROM THE UNITED STATES CENSUS REPORT TO SHOW HOW THE OPENING OF THE SCHOOLS IN AUTUMN INCREASES DIPHTHERIA.
The broken link shows the number of cases among school children 5 to 14 years old during 1900-1904 in the Registration Area of the United States. The unbroken line shows the number of cases among children from birth to 5 years of age for same period and area.

minded and insane. Doctor Newmayer says it has been claimed that of the inmates of an asylum for the feeble minded, 25 per cent could have been made normal men and women by the correction of physical defects and proper training in early life. Among our 8,000 deaf and 5,000 blind citizens of this state, at least several hundred of them could have been saved from their unfortunate condition by medical inspection.

The journal of the American Medical Association records the following striking benefit from medical inspection in Philadelphia: The city council appropriated $300.00 for glasses for children unable to pay for them, and with this money 354 children were fitted with glasses. These children without glasses could not read from the blackboard and could not see the print in their books; in many instances they were thought backward and often mentally deficient. Correction of these defects by the fitting

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of proper glasses was followed by remarkable improvement in the work and conduct of the pupils. Children in special schools were enabled to return to the regular schools. A large amount of malnutrition, dyspepsia and other physical ills resulting from the carious teeth present in more than a quarter of a million of the school children of Pennsylvania, is capable of being remedied by medical inspection to an extent which can scarcely be estimated in dollars and cents. Medical inspection would detect diphtheria in its very beginning, and, thus, not only prevent further infection, but also make possible the use of the one certain remedy, antitoxin, at a time when its efficiency is greatest. In this way, it is probable that nearly one-half of the 1,000 deaths from diphtheria among the school children of this state could be avoided. In Japan where the most perfect form of medical inspection prevails throughout the entire Empire, scarlet fever is almost unknown and the diphtheria death rate is less than one-third of what it is in the United States.

Inspection in the Cincinnati schools during the first six months of 1907, revealed over 1,000 pupils suffering from contagious diseases, ranging from itch to scarlet fever. If these children had been permitted to remain in school, others would have been infected, and further

ELEVEN-YEAR-OLD BOY SHOWING AN ENLARGED GLAND AT THE SIDE OF THE NECK CAUSED BY TUBERCLE BACILLI, WHICH ENTERED THROUGH HIS ENLARGED TONSILS. ALSO HIS EYES ARE NEARLY RUINED BY NEGLECTING THE USE OF GLASSES.

These defects which medical inspection might earlier have remedied have put him three years behind his grade and ruined his health.

CHART CONSTRUCTED FROM THE REPORT OF THE PUBLIC HEALTH AND MARINE HOSPITAL SERVICE FOR THE SIX LARGEST CITIES IN THE UNITED STATES IN 1908.

The broken line shows the number of cases of scarlet fever reported in each month, and the unbroken line those of diphtheria. The large increase during the first warm days of May is due to the more frequent use of the common drinking-cup.

sickness and death resulted. Our state law compels children to attend school. Unless there is medical inspection, no school can be kept free of contagious diseases. As a result, we are subjecting children to a needless risk of infection, likely to cause sickness and, in many cases, death.

The minor ailments, such as pediculosis, itch, and ringworm are serious maladies when it is remembered that they may be the cause of sleeplessness and nervousness, which being long continued, may lead to prostration and insanity. Over 7,000 cases of pediculosis were found among school children of Massa-

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chusetts in one year. Dr. Newmayer states that medical inspection reduced the percentage of pediculosis in certain schools in Philadelphia from thirty to eight. Improvement in cleanliness, which has an influence on moral character, has been noteworthy in schools after the inauguration of medical inspection.

ENLARGED PHOTOGRAPH OF HEAD LICE COMBED FROM A SCHOOL CHILD'S HAIR.

The benefits, then, to be derived from the medical inspection of school children are a saving of many thousands of dollars spent in instructing backward pupils, the prevention of much sickness and suffering, the warding off of a considerable amount of early death, and the remedying of numerous defects in childhood which are certain to limit the usefulness of the future citizen, and in a considerable number of instances make him an object of charity and sometimes even a criminal.

ALL MEMBERS OF ONE FAMILY AND ALL HAVE TUBERCULOSIS.
The two older children felt well enough to go to school and drink from the common cup until medical inspection discovered their disease.

If medical inspection is to prevail, it should be made as efficient as possible. With the results of the experience of others, the opinion must be upheld that both kinds of inspection should be undertaken, the one for the detection of contagious diseases, the other for physical defects. The work relative to contagious diseases should either be related to or under the direction of the board of health, while the physical examinations should be directed by the school authorities.

The experience with school nurses in Boston, New York, Philadelphia and Harrisburg proves that medical inspection can only reach its greatest efficiency when the inspectors' work is followed up by that of the nurse. Contagious eye and skin diseases and other simple maladies can be speedily cured under the watchful eye of a nurse whereas if the patient is left to the treatment of a careless parent, months or even years may elapse without a complete cure, while the pupil is debarred from the benefits of the school. The work of the inexpensive nurse greatly lessens the cost for the expert work of the doctor. Working together,

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one physician on less than half time and a nurse on full time can render proper inspection for 2,000 children. In Camden one physician is employed for over 9,000 children, but his entire time is given to the work.

While we are waiting for the necessary appropriation for thorough medical inspection, it seems to me wise that a beginning in the work should be made at once by every teacher. It requires but little skill to test for defective sight and hearing and to observe defective teeth and abnormal breathing. This simple inspection will add greatly to the personal interest which the effective teacher has in the welfare of her children, and will hasten the time when a public school will not dare to neglect its most important duty and send out into the strife of life pupils maimed in eye, ear or mouth.

Without medical inspection we know that we shall have thousands of school children in each state annually suffering from preventable disease. Neglected eyes, and middle-ear and throat inflammations will add in the next generation largely to the thousands of blind and deaf citizens of our commonwealth. The work of Cronin of New York, Ehler of Cleveland, and Cornell and Witner of Philadelphia, fortify and give strong credence to the recent statement of Doctor Newmayer: "Truancy, child labor, the juvenile criminal, and the moral and mental defective, in greater part, have their origin in the unrecognized, unattended, physically defective pupil." A school system, fostered by a great commonwealth like that of each state, must seek the highest efficiency in the preparation of citizens, both morally and physically, as well as mentally, and it cannot do this without medical inspection in the public schools.

BUT SIXTEEN OF THESE CHILDREN ATTENDING SCHOOL IN NEW JERSEY USE TOOTH BRUSHES.

The mouth-breather is one of the most easy to detect of these deficients. There is a vacancy to the eye, a listlessness in manner, while the widely parted lips, and the pinched appearance of the nose too plainly evidences that the air passages for the normal entrance of air are closed. Persons thus affected usually have very narrow chests, due to the fact the lungs are never fully expanded. Worst of all the absence of oxygen results in a diminution, often to a very serious degree, of the red corpuscles. The voice takes on the characteristic sound as of one "talking through his nose."

Greece and Rome once led the world. Strangers visited their shores and left with the death angels of the morass encircled lands a new enemy which in the following night was planted in the noble blood of Southern Europe. Malaria turned strength into weakness. Because they did not rise to this new emergency and put down this enemy to physical vigor, Greece quickly receded from the rank of a world power and Rome as a nation sank into oblivion. The advent of the foreigner in our midst, the change from rural to urban life and the adoption of other unhygienic habits demand new safeguards for preventing physical deterioration, and one of the most important is an honest and thorough medical inspection in the public schools of this country.

The Daffodils

I wandered lonely as a cloud
  That floats on high o'er vales and hills,
When all at once I saw a crowd,
  A host of golden daffodils,
Beside the lake, beneath the trees,
Fluttering and dancing in the breeze.

Continuous as the stars that shine
  And twinkle on the milky way
They stretched in never-ending line
  Along the margin of a bay;
Ten thousand saw I at a glance,
Tossing their heads in sprightly dance.

The waves beside them danced, but they
  Outdid the sparkling waves in glee;—
A poet could not but we gay,
  In such a jocund company;
I gazed, and gazed, but little thought
What wealth that show to me had brought.

For oft when on my couch I lie,
  In vacant or in pensive mood,
They flash upon that inward eye
  Which is the bliss of solitude;
And then my heart with pleasure fills,
And dances with the daffodils.

—WORDSWORTH.

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The Miracle Workers

By Berton Braley

The "Dreamers of Empire" travel in style
    On a glitterin' palace car,
An' they look with a dignified, scornful smile
    On the kind of men we are;
They pay us the smallest pay they dare
    An' call us a "frowsy crew,"
But they know — an' a hell of a lot they care —
    We're making their dreams come true.

Work an' women an' fight,
    Dice an' women an' drink;
A spree on pay day night,
A day or two in the clink,—
A fine old life to live,
An' a low down life, says you?
But we ain't dreamin' no dreams ourselves,
We're makin' your dreams come true.

Presidents ponder an' managers scheme,
    But we are the guys who sweat
Creatin' the real thing outen' the dream
    An' doin' it right, you bet!

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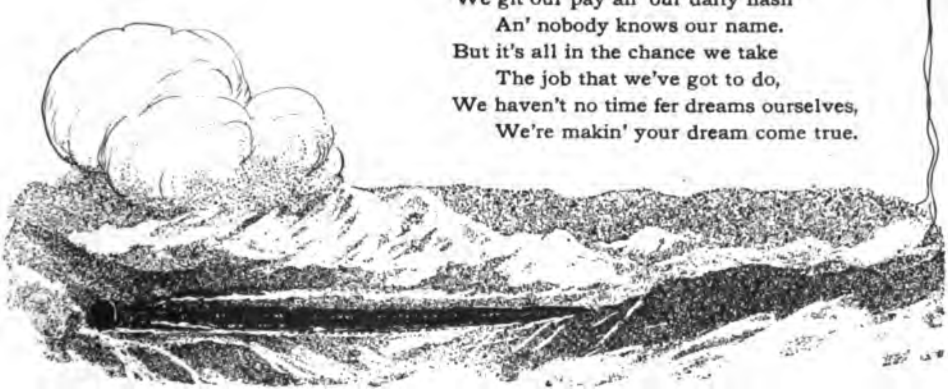
We loaf when we kin and work when we must,
    Our morals is mighty few,
But winter an' summer, snow er dust,
    We're makin' the dream come true.

Hogan an' Schmitz an' Jones,
    Levisich, Schwank, LeBeau,
Talkin' in heavy tones
    Wotever Lingo they know;
Dago an' French an' Russ,
    Irish an' English, too,
Hairy an' hard an' coarse an' rough,
    Makin' the dream come true!

There ain't no medals run off for us,
    We're tickled to get our pay,
An' there ain't no papers makin' a fuss
    When some of us pass away;
We're nothin' but hobos from hobo town
    Puttin' the railroad through,
Cuttin' the cliffs an' the mountings down,
    An' makin' the dream come true.

The big bugs git a chunk of cash
    An' most of the praise an' fame:
We git our pay an' our daily hash
    An' nobody knows our name.
But it's all in the chance we take
    The job that we've got to do,
We haven't no time fer dreams ourselves,
    We're makin' your dream come true.



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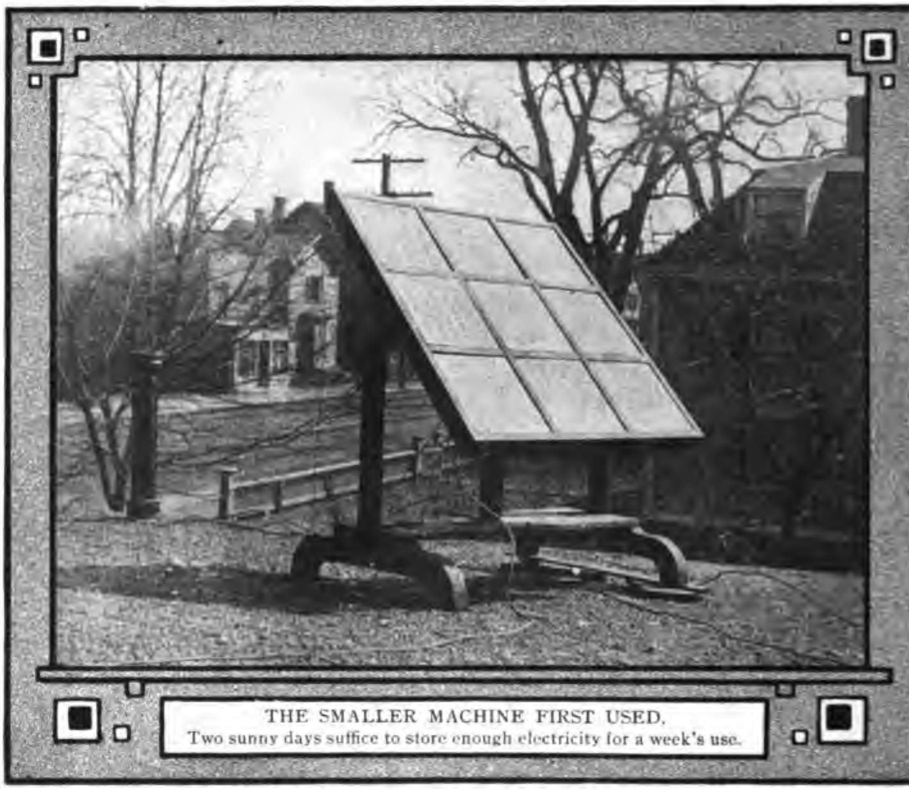

THE SMALLER MACHINE FIRST USED.
Two sunny days suffice to store enough electricity for a week's use.

POWER FROM SUNLIGHT

By WINTHROP PACKARD

TO catch the light of the sun, bottle it and have it on tap, to be turned on at will in dark places is the latest feat of American inventive genius. Indeed the new machine does more than store the sun's rays, for it derives from them a form of energy which may be transformed into heat or power as well as light. Thus becomes true a dream of the ages past, a dream that would seem to be as utopian as any magic feat of the genie of Arabian tales.

Since the days of Archimedes, inventors have worked from time to time on schemes for utilizing the heat of the sun's rays as a source of power, and one device after another has given partial success only to be doomed to failure on a prolonged practical test. Most of these solar engines have depended on the concentration of the sun's rays by means of mirrors and prisms, focusing the heat on a boiler where steam is generated and used in the usual way. More than one complicated and expensive apparatus of this sort stands useless today. You will find them scattered through the southwestern part of the country in particular,

WINTHROP PACKARD.

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for there the sun shines most of the time, some places having three hundred or more bright days during a year. There is no lack of heat in the sun; the trouble comes in the complicated mechanisms which fail to grasp its elusive power in such manner as to retain it.

Now appears before the startled scientific world the invention of a Massachusetts man, George H. Cove, which proceeds along entirely new lines and lays a simple but cunning and effective trap for the electrical energy which the sun generates in enormous quantities and sends along his beams earthward. This source has never before been tapped, at least in a way to make it a commercial possibility. So simple is the device and so direct and positive its work that it is no wonder that it has been overlooked or never thought of, either by inventors of electrical appliances or those people who have tried by various mirror and prism schemes to entangle the sun's energy and set it at work. Simplicity is the startling part of many a great invention.

G. S. Cove, Inventor of the Solar Electric Generator.

What might be called the primary cell of the "solar electric generator," as the inventor names it, is a three inch long rod or plug of metallic composition, an alloy of several common metals, on one end of which the sun shines in a glass-enclosed space, the other end being in the shadow, in cool free air. This rod is part of a circuit wired in the ordinary way to any good storage battery. While the sun thus shines upon one end of this rod the difference in temperature between that and the other end, and also the difference in other conditions caused by the direct rays in one case and their absence in the other, a difference not wholly understood by the inventor at present but now being experimented upon, sets up an electrical action which is passed along to the storage battery and there held in reserve to be turned on as light, heat or power as desired. The amount of energy trapped and thus stored by one rod in a day is of course small, but it is a simple matter to hitch up any number of these rods in batteries and thus make their individual work cumulative. A thousand rods may be placed side by side in the space of an ordinary window-sash five feet square and the electric force thus generated is a thing to be reckoned with.

The device as used at present consists of a frame very like a sash with sixteen panes, each pane enclosing the sun-ward end of sixty-one plugs, a total of nine hundred and seventy-six. These plugs are set in a composition of asphalt and other material which required considerable study to produce to fit the required conditions. It is necessary that this composition be a non-conductor of heat, of light and of electricity, and of sufficient strength to hold the plugs firmly. The glass casing holds the sun-ward ends of these in motionless, heated air; the other ends are in the shadow and the breeze. The sash itself stands on a simple stand on a flat roof, or it may be allowed to rest on a southerly exposed, ordinary sloping roof, or it may stand on the ground for that matter, the only requirement being that the sun shall strike it fairly. Here again experience has proved that the device is more simple in its

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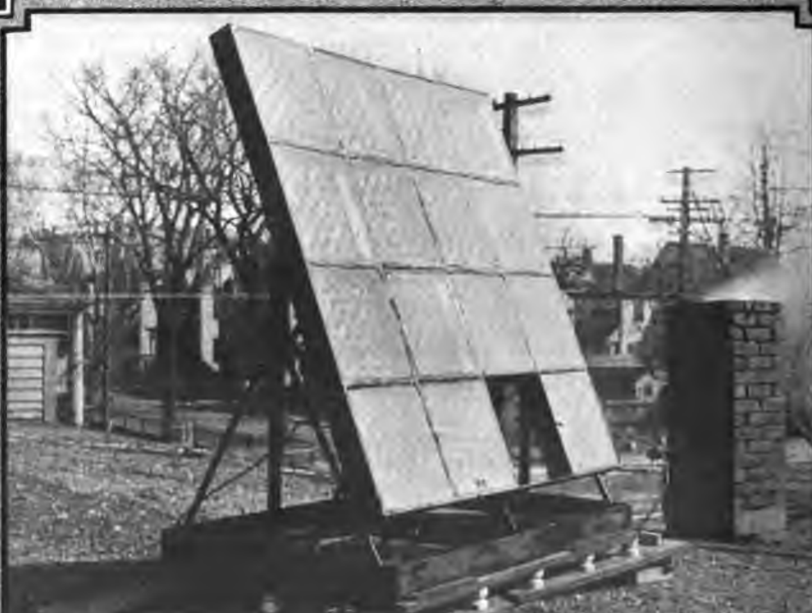
action than at first supposed. With his first sash the inventor thought there would be a loss in energy unless the sun shone on it perpendicularly all day and was preparing a mechanism whereby the sash might be turned with the sun as it passed from east to west and from the horizon toward the zenith and back again. No such complication, however, arises. The electrical energy seems to be generated in equal quantity under slanting rays as under those which fall perpendicular.

This, coupled with the fact that the machine when exposed to various sources of artificial heat gives no electrical energy whatever, would seem to lead to the conclusion that other than the ordinary heat rays of the sun, perhaps the ultra-violet rays, are active in setting up the electrical current.

But whatever the cause, whether the peculiar quality of heat that is generated by the sun's rays, or a complicated action of both sun-heat and light, or yet a certain electrical energy which passes from the sun to the earth, using the direct rays as wires, so to speak, the fact remains that this simple device is a probable breeder of a revolution in sources of electrical energy. At first it will be applied only in a small way, no doubt; as a private house lighting electric plant, for instance.

The present cost of such a machine as pictured in this article need not be much over a hundred dollars. It is as indestructible as a kitchen range. Properly secured and wired upon a roof, or any other spot where it gets the day's sun unimpeded it needs no further attention.



LATEST TYPE OF SOLAR ELECTRIC GENERATOR.
This machine stores a week's power for an ordinary dwelling in a day.

Even in its present somewhat crude and experimental state, given two days' sun it will store sufficient electrical energy to light an ordinary house for a week. The inventor has proved this now for months in his own establishment. Thus, in portions of the country where even one day

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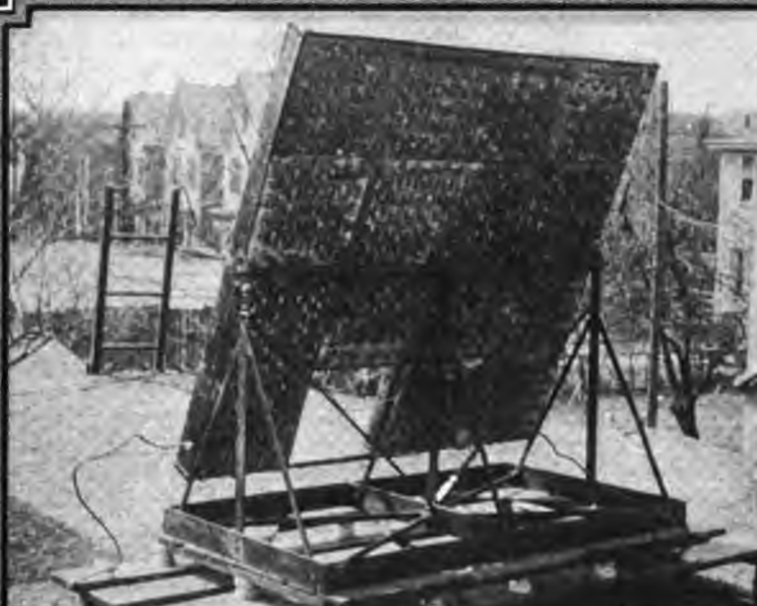
in three is sunny a single machine five feet square and holding less than a thousand plugs is sufficient for the ordinary lighting of a house. The possibilities of the amount of power which might be obtained in the future by batteries of these simple devices working without expense and with a minimum of attention are simply staggering. The machine has been made automatic by a mechanism which shuts off the battery when the sun's rays cease to strike the surface and opens the connections again at the touch of the sun in the morning. This works also on days of alternate sun and shade, opening up connections during sunshine and closing them during shadow.

Of course the fact that the sun's rays are capable of producing enormous energy is no new thing to science. Ericsson, the inventor of the civil war monitors which revolutionized naval warfare, demonstrated in 1868 that the sun's rays give a horsepower per square yard per hour. It was thus shown that the amount of energy ready at any man's door, but then as now going to waste for lack of adequate harness, is enormous.

Scientists also continue to demonstrate that coal and oil, at present the common great sources of energy and artificial light, are rapidly being depleted and that in another hundred years they will have become scarce if not exhausted. The country at large is turning toward water power which is now but partly utilized. But water power sites are expensive to obtain and are rapidly being taken up by powerful interests. Like the coal and oil, water power is not within the reach of the average man. If he is to use it in the future he must buy it from the capitalist as he does now from the coal baron or the oil king. It is difficult, however, to see how any commercial corporation or combination can monopolize the direct rays of the sun. They strike every man's



A REAR VIEW OF THE DEVICE THAT BOTTLES THE SUNLIGHT.

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roof or his dooryard, and with a "solar electric generator," it is possible to trap them, store them in any good form of storage battery—the inventor uses one that is common on automobiles—and turn them on at will to do the desired work, whether lighting a room or heating a chafing dish or running a sewing machine or churn.

The invention is not one of the oft-heralded hap-hazard "discoveries." It is the result of many years of careful investigation and patient labor on the part of a man whose business it is to invent, as is was that of his father before him. Mr. Cove is a native of Halifax, Nova Scotia. His father patented many mechanical devices which are in use at the present day, some of these being important in the large flour-making establishments of the West. He, himself, takes great pride in a gold medal recently received from the Canadian government for his model of a machine and a plan for harnessing the tides of the Bay of Fundy.

MAKING OATS SELF-SUPPORTING

By F. G. MOORHEAD

FOR the first time in the history of agriculture growing oats is to be made profitable and this in face of the fact that the oats crops in the United States in the past eight years have been sufficient to pay the interest and non-interest bearing debt of the nation twice over.

The gospel of profitable oats was preached this spring throughout the length and breadth of Iowa—the leading oats producing state of the nation—and in portions of South Dakota by a devoted band of young men, headed by the intrepid explorer in the field of agronomy who started the first "corn gospel" train on its memorable journey five years ago. "Oats gospel" trains were run over the Chicago, Rock Island and Pacific railroad, the Chicago, Milwaukee and St. Paul railroad, the St. Paul and Des Moines railroad and the Illinois Central railroad, traversing several hundred miles, the preaching being heard by fully 10,000 farmers.


F. G. MOORHEAD.

The average American partaking of his matutinal porridge has never realized that the American farmer has raised the oats which forms the bulk of the breakfast foods at a financial loss. But such has been the case. Last year Iowa planted 4,200,000 acres to oats and reaped a crop of 108,900,000 bushels of an aggregate farm value of $41,382,000; while Illinois raised 101,675,000 bushels of an aggregate farm value of $41,687,000. These immense totals would seem to indicate profit. Give one year's oats crop of Iowa and Illinois to a railroad president and he could add 2,686 sleeping cars or 4,632 day coaches to the rolling stock of his railroad. Or give to Uncle Sam the $334,568,000 secured from the sale of oats raised on the 32,000,000 acres planted to that grain throughout all the United States and he could add to his naval strength 125 battleships of the size and armament of the Illinois, so that no other nation on the globe would have even a look in when it came to war. Take the money earned by the nation's oats crop for the past eight years and the American farmer could lay on the table a dollar for every dollar every railroad president in America, Africa, Asia and Australia could lay down for every receipt from every source of revenue.

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But these big things do not tell the tale. Twenty-six farmers in the oats belt, interrogated as to the cost of raising oats, reported the average expense per acre as follows:

Three bushels of seed	$1.58
Preparing the ground	1.45
Harvesting	1.22
Stacking	.50
Threshing	1.20
Rent and repairs	4.19
Total	$10.14

Taking Iowa's yield in 1908 and the average price of oats, an acre's crop brings the farmer $9.55, leaving a loss for each acre of fifty-nine cents. On the 32,000,000 acres planted to the grain in the whole country the total loss would be $18,880,000.

Why, then, in the face of this great loss, has the American farmer continued to grow oats? It has not been solely because of a philanthropic, hygienic belief that the nation should eat less meat and more oatmeal porridge. Oats has been a nurse crop. On it, as it shot up out of the ground quickly, ripening so as to be harvested early in July, has devolved the duty of shading from the burning rays of the sun the tender shoots of clover and timothy with which it has been sowed until they have become strong. Then the oats has been harvested and the grasses, needing their nurse no longer, have grown into dollars and cents for the farmer. Again, rotation of crops has been a factor. Sixty years ago a man bought an Illinois farm of 120 acres. He has farmed it continuously without any intelligent rotation of crops or provision for returning to it the plant food taken from it. The land used to yield 35 bushels of wheat to the acre. The last wheat crop from it was two bushels to the acre. The last corn crop averaged about ten bushels to the acre, the state average being 36 bushels. Other farmers have been wiser; they have allowed the ground to rest from the demands of wheat and corn and have grown oats and other products demanding different elements of fertility; at a loss, perhaps, but at a profit in the long run of years.

PROF. P. G. HOLDEN, OF IOWA STATE AGRICULTURAL COLLEGE.
Originator of the idea of teaching farmers by sending agricultural experts to them on special trains.

Now it is proposed to make oats stand erect for the first time, self-supporting. It can be done, say these enthusiastic agronomists from the agricultural college experiment station which gave Secretary James Wilson to three presidents and the nation. These men believe that the oats crop of the Mississippi Valley can be doubled. They have turned the trick at the state experiment stations and they are certain the American farmer, if he will follow their advice, can do likewise.

Four principal rules are to be followed. These relate to fanning and grading seed, treatment for smut, preparation of the seed bed and seeding with a drill instead of broadcast. In addition, the "early seeding" slogan has been raised. Follow these rules and two heads of oats will grow where but one grew before.

In their addresses to the thousands of oats growers who crowded the "oats gospel" trains these agronomists urged first the importance of selecting early varieties. Tests ranging over a long period have proved that the early variety will assure a larger yield in unfavorable as well as favorable seasons. Experiments have shown that the large plump oats berries yield better than the medium

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Farmers Who Came to Greet the "Oats Gospel" Train. One Man Walking Ten Miles.

or small, though the latter may be round and heavy. An average of tests ranging over seven years shows the following rate of production: large berries, 62 bushels to the acre; medium, 54 bushels; small, 46 bushels. Of almost equal importance is the test for smut, the cleansing of the seed. An examination has shown that there was only .8 per cent smut in a field of oats the seed of which had been treated, as compared with 7.9 per cent smut in a field not treated. A solution of formalin to free the seed of smut is recommended. One pint of this solution, of which the cost is nominal, diluted in forty gallons of water is sufficient to cleanse forty bushels of seed, enough to plant fourteen acres of ground. Moreover, the oats grower was impressed by these agronomy preachers with the importance of leaving the seed to dry thoroughly, after it has been treated with the solution of formalin. It should be spread on a floor, at a thickness of a few inches, and the formalin sprayed upon it. It should be stirred often and given every chance to dry. At least twenty-four hours should be allowed.

This information, together with advice to have the seed thoroughly fanned before planting and to have the ground disked rather than plowed and the seed planted by a drill instead of broadcast, was given at every station where the "oats gospel" train stopped in the month devoted to the crusade. Exhibits were made in the cars, literature distributed and the gospel of more and better oats spread broadcast. Harvest time will show the result. That it will be satisfactory and profitable there is every reason to believe, mainly because the experiment stations have proved that the oats crop can be doubled by these meth-

DRILLING IN OATS—THE RIGHT WAY TO PLANT THE SEED.

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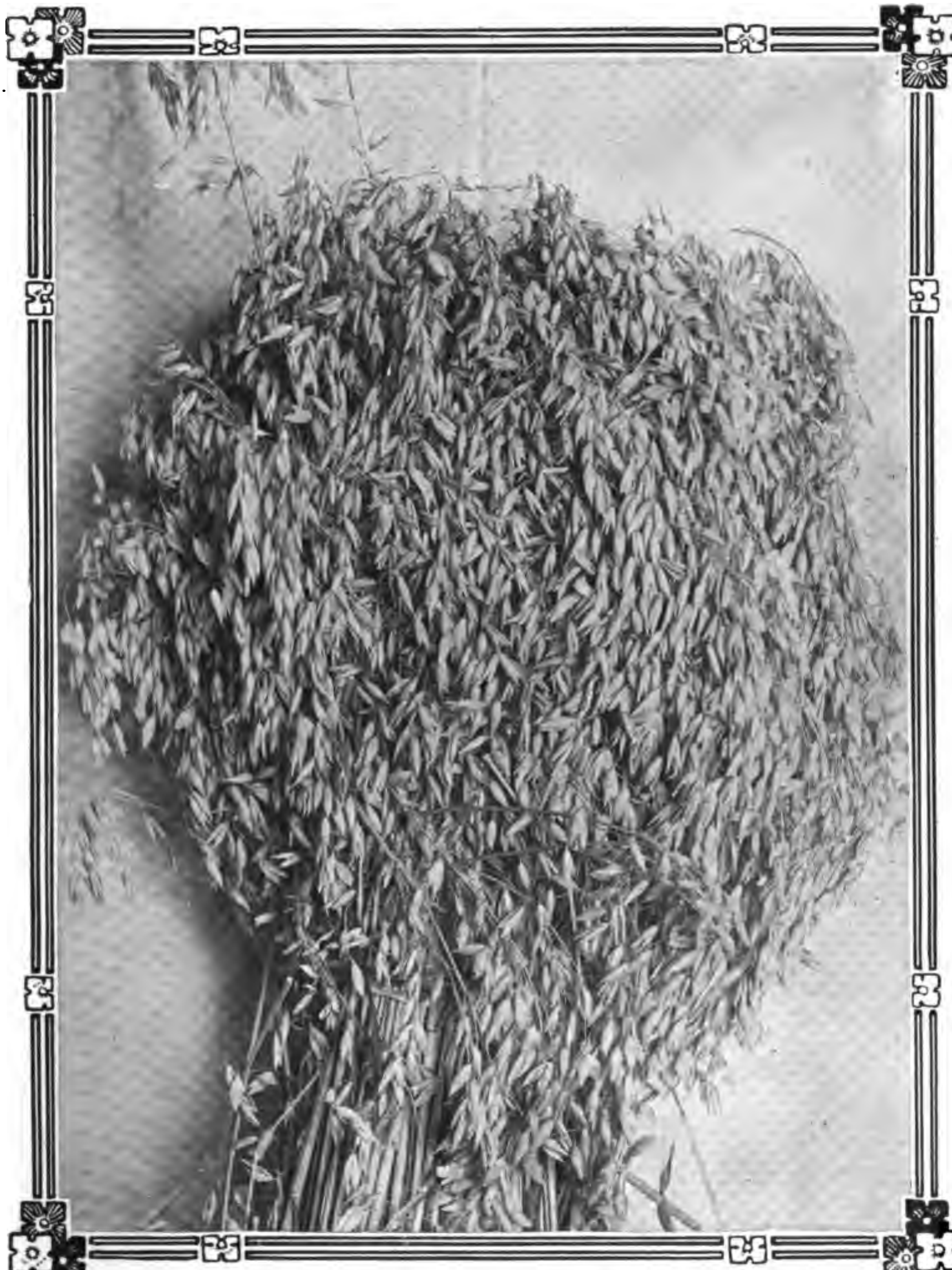

SHEAF OF OATS FROM WENATCHEE VALLEY, WASHINGTON, EXHIBITED AT THE ILLINOIS STATE FAIR, 1908.

This is the kind the "oats specials" are teaching Mississippi Valley farmers to grow.

ods and because these same agronomists have taught the farmers how to increase the corn crop many million bushels.

It was five years ago that Prof. P. G. Holden sprang into prominence as the originator of the idea of having experts travel on special trains through the agricultural sections to preach the gos-

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pel of better corn, oats, wheat, dairy products and roads. The plan had been in his mind practically all his life. Twenty years before, when a country school-teacher in Michigan, he decided to test the observance of his pupils. One day he called them about him and asked "How many hairs are there on a rat's tail." There was a variety of answers. "Ten," said one; "fifty," said another; "one hundred," said a third. No one knew positively. "How can you find out?" continued this queer school-teacher. "Look in the dictionary," piped up a youngster, but another was more practical. "Teacher," he said, "I'll catch a rat and see." "That's the only way," said Prof. Holden and school dispersed. The next morning the scholars appeared before him shamefaced; they had learned by observation that there are no hairs on a rat's tail.

The next thing this peculiar teacher did was to tell his pupils to select the best ear of corn in their father's cribs and bring it to school. They did so and he graded the exhibits. When the children reported this at home their fathers were wrathy; who was this school-teacher that he should pretend to know more about corn than they knew? But Prof. Holden went serenely ahead, instructing his pupils to plant three seeds of the best corn they could get in a box and water it. The result was a crop packed with large kernels which opened the eyes of the parents who thought they knew it all. The greater result was an end forever to corn failures in Michigan.

After that, Prof. Holden took the chair of agriculture in the Illinois Agricultural College. Near Bloomington is the 25,000 acre farm of the Funk Brothers, 20,000 acres planted to corn. Prof. Holden asked the yield. "Forty to fifty bushels," he was told. "It should be more," he replied. He showed them how to select the best seed corn and plant it carefully. He became director of the farm and on some acres raised as high as seventy bushels of corn. The increase in yield the first year was 10,000 bushels.

WOMEN, AS WELL AS MEN, WERE ATTRACTED BY THE AGRICULTURAL EVANGELISTS.

This crystallized the idea some day to teach the people of all the corn belt as he had taught the Funks, but it was not until Prof. Holden had moved over to the Iowa State Agricultural College that he tried the experiment. He continued his tests there and finally one day in the early part of 1904 he presented himself in the private office of a big railroad official in Chicago with the modest request that he be furnished a special train of Pullmans, diner and day coaches and be hauled wherever he might wish over Iowa, Illinois and Missouri, absolutely free of charge.

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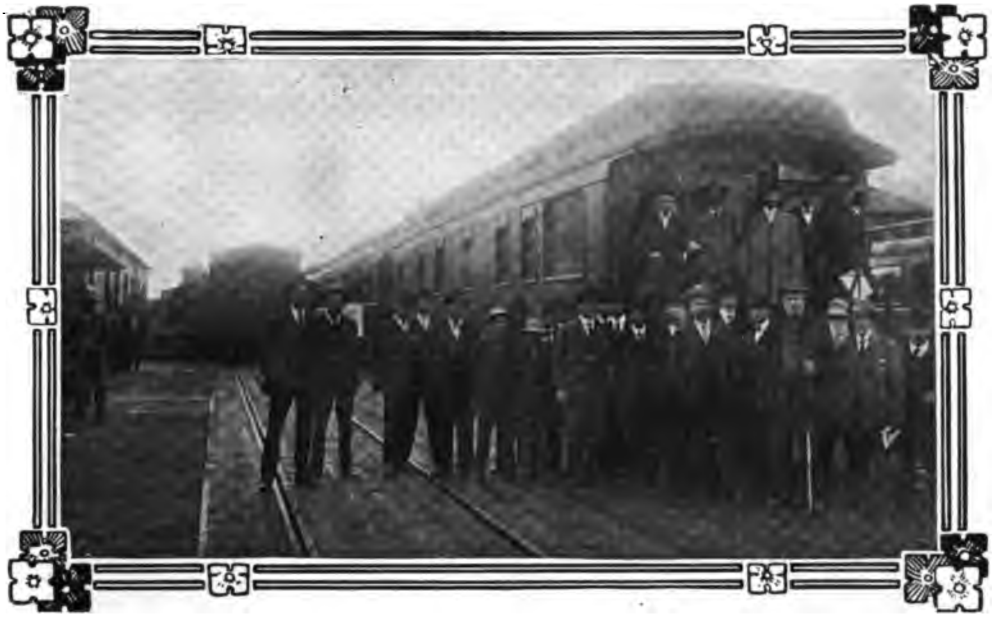

THE INSTRUCTORS—PRACTICAL AGRONOMISTS, WHO KNOW BY EXPERIENCE WHEREOF THEY SPEAK.

It is not on record just what the railroad man said to this unknown school-teacher, but it is on record that Prof. Holden explained to everybody he met in those days that an increase of one bushel of corn to each acre devoted to corn-growing in Iowa alone would mean an increase in one year of $2,660,395.20. It did not take the railroad magnate long to figure out that the school-teacher knew

THRESHING OUT THE HARVEST OF OATS.
Scene on an Iowa farm.

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what he was talking about. Increase the corn yield, there would be more freight to haul; increase the wealth of the farmers they would do more traveling and buy more machinery and goods for the railroads to transport; railroad receipts would go up with leaps and bounds.

When Prof. Holden quit the railroad office he carried with him an order for the special train.

Such was the beginning of the universities on wheels, carrying the message of the new agriculture to the homes of the farmers who had neither the time nor the money to go to the agricultural colleges and learn the new-fangled ideas in which they had never put much faith, getting them only by exaggerated and perverted hearsay.

That first year the "corn gospel" trains traversed the length and breadth of Iowa, Illinois and Missouri. The following year the field was enlarged and requests for Prof. Holden to visit and teach came from California, Connecticut, Washington, Maine—all over the country. Then the idea spread and trains were started to teach farmers how to make more and better butter, how to get and keep good roads, how to grow more wheat—and so on and on.

The "oats special" was the latest development of the idea. Prof. Holden was back of it and with his assistants spread the gospel of self-supporting oats right and left in the state which grows more oats than any other state in the world. What will come next no man definitely knows; but the American farmer with his granaries full to overflowing and his bank roll plethoric is certain it will be something to his profit, for whether he hails from Missouri or not he has been shown.

When Life Is Young

O life! How pleasant is thy morning,
Young Fancy's rays the hills adorning!
Cold-pausing caution's lessons scorning,
We frisk away,
Like schoolboys at th' expected warning
To joy and play.

—Burns

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KWATAKA—"MAN EAGLE"—THE MEN'S DORMITORY.
UNIVERSITY OF NEW MEXICO.

PREHISTORIC HOME for NEW UNIVERSITY

By Ramon Jurado

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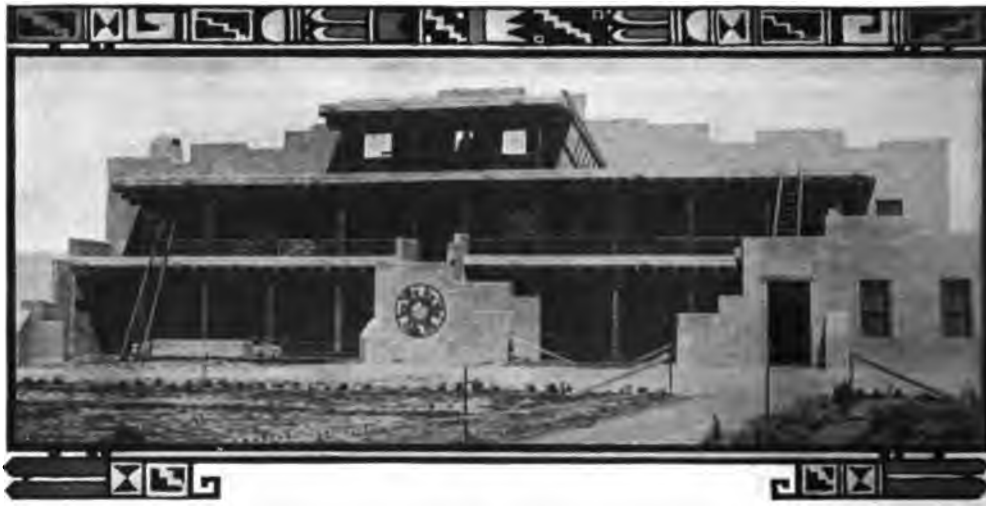

HOKONA—"BUTTERFLY MAIDEN"—WOMEN'S DORMITORY.

TO perpetuate for all time the architecture of a dying race; to preserve for the archeologists, anthropologists and ethnologists of future generations types of buildings which were evolved by the first dwellers on the great American desert, the State University of New Mexico has entered upon the most remarkable campaign of building ever undertaken by any individual or corporation since white men came to the New World.

Barely ten years old, situated on a rolling mesa whereon multiplied mountain ranges frown, overlooking the peaceful valley of the Rio Grande and the city of Albuquerque, the site of the university is identical with many of the sites of the prehistoric cities known as "pueblos." In the ruins of these cities of a race which is slowly passing into oblivion have been found some of the greatest treasures of American anthropology. The communal towns themselves, each being merely one great house, built room on room to suit the needs of increasing population in their flourishing days, are almost the only records left of the mysterious tribes who built them.

One of these communal cities the University of New Mexico is reproducing faithfully in every detail, on its campus, to serve as dormitories and classrooms for its students and as a dwelling place for the members of its faculty. Two or three large buildings have already been erected, and these are being united and extended as fast as possible until, ultimately, all the college buildings will be under one roof, and all will make up a complete pueblo city.

To understand this, the only building scheme of its kind in the world, it is necessary to pause for an instant and take a look at one or two of the present cities of the Pueblo Indians. These towns, as is well known, stand on mesas in the Arizona and New Mexico deserts. Among the best known are the pueblos of Zuni, Acoma, Hualpi (sometimes spelled "Wolpi"), and Moqui. There are others of these towns, but these are the most commonly seen by travelers through the desert.

All of these are built on the principle, not of many houses to make a city, but of many rooms of different shapes and sizes, each occupied by a family, and all joined together under one roof to make one huge house-town, wherein lives the entire tribe. When these towns were founded no one can say with certainty. They were old when Coronado journeyed north to the Rio Grande in search of the fabled "Seven Cities of Cibola" in 1540.

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In fact, it is likely that the legends of these seven cities were originally woven about the pueblo towns of the desert Indians, but the great Conquistadore did not know this, and, though he saw the pueblo cities, he passed them by and never found the golden dream he sought.

Presumably the tribes which built the communal cities were descendants of the cliff-dwellers, after more northern and more warlike tribes had driven them from their crag-hung nests. The cliff-dwellers in turn, probably were the remnant of the people which once inhabited Casa Grande, the largest prehistoric city on the North American continent, within whose environs once lived and loved and died 300,000 souls.

But, be that as it may, the present communal cities of the plain show many traces of Spanish influences in their architecture. President W. G. Tight of the University of New Mexico, however, wished to preserve the Indian style of building pure and uncontaminated, so he sought the ancient and deserted prehistoric pueblo town of Sikyatki, oldest of all this type of settlements now known to man. Situated in northern Arizona, well hid by beetling mountain walls and set on a little mesa looking far out through the canyons and gorges of the ranges, it still contains many buildings with which the hand of time has dealt lightly. Near it are the Tusayan pueblos, now occupied by scattered remnants of tribes which once reached a high degree of civilization, but which are now all but extinct.

STEPS LEADING UP INTO KWATAKA—THE MEN'S DORMITORY.

Sikyatki was a crumbling ruin when Coronado came, and now lies about three miles from the small town of Isba. In

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1895 Dr. J. Walter Fewkes of the Bureau of Ethnology made an exploration of this ruin and, from his descriptions of the buildings, plans for the pueblo university were made. And it should be said here that the pale-face student of the Southwest seems to take as kindly to the cool-in-summer, warm-in-winter type of architecture as did his more pigmented step-brother of several centuries ago.

Built story on story, the highest and oldest structure in the center, with the rooms grading down like huge blocks all around it, the pueblo of Sikyatki presented the appearance, at a distance, of a huge pyramid. A basis for this effect has been laid on the university campus, and the plan will be faithfully followed out, until all the buildings of the school are arranged in the same style. The largest of the structures already erected is "Hokona," the women's dormitory. Hokona is the Tusayan or Sikyatki symbol for the butterfly. But instead of following out the old Greek theory of Psyche, the soul, as a definition of butterfly, the dwellers in the ancient city applied it to all maidens, consequently, Hokona has become the Butterfly-Maiden, and emblem of purity and beauty.

SUN DIAL MEMORIAL OF THE CLASS OF 1907.

Similarly, the men's dormitory, which is a trifle smaller than that in which the fair co-eds will dwell, bears the symbol of Kwataka, the Man-Eagle, a legendary monster which was believed by the Sikyatkians to dwell in the sky and to lie constantly in wait for wanderers from the pueblo city, to carry them away to his lair and there devour them. Finally the war-god of this primitive people overcame Kwataka and the pueblo was relieved of his raids. Symbols accurately reproduced from the walls of Sikyatki, both of Hokona and of the monster Kwataka, adorn the entrances to the women's and the men's dormitories, respectively.

The dormitories are built of brick, covered with a thick coat of rough cement, carrying out in detail even the structural methods followed by the Indians centuries ago. Stone blocks as well as adobe bricks were used by the builders of Sikyatki and the modern pueblo villages are covered with cement — or rather a smooth adobe plaster—exactly the same in appearance as the more durable covering of the university buildings.

Flat roofs crown these dormitories, furnishing broad sun porches on the top of each story. All timbers used are roughly dressed logs, brought from neighboring mountains, just as of old the Pueblos brought timbers for many miles on the backs of men to furnish rafters, door and window sills and lintels for their communal homes. The timbers of the university buildings, too, are innocent of nail or screw, being mortised, tenoned and pinned with wooden pins, after the fashion of the ancient Indian dwellings.

Winding, walled stairways lead from the ground up the outside of these buildings, seeming much like the sinuous carved trails which give access to the lofty mesas on which are situated the pueblos of Hualpi and Acoma. Entrance to the communal buildings of the aborigines is gained by means of ladders

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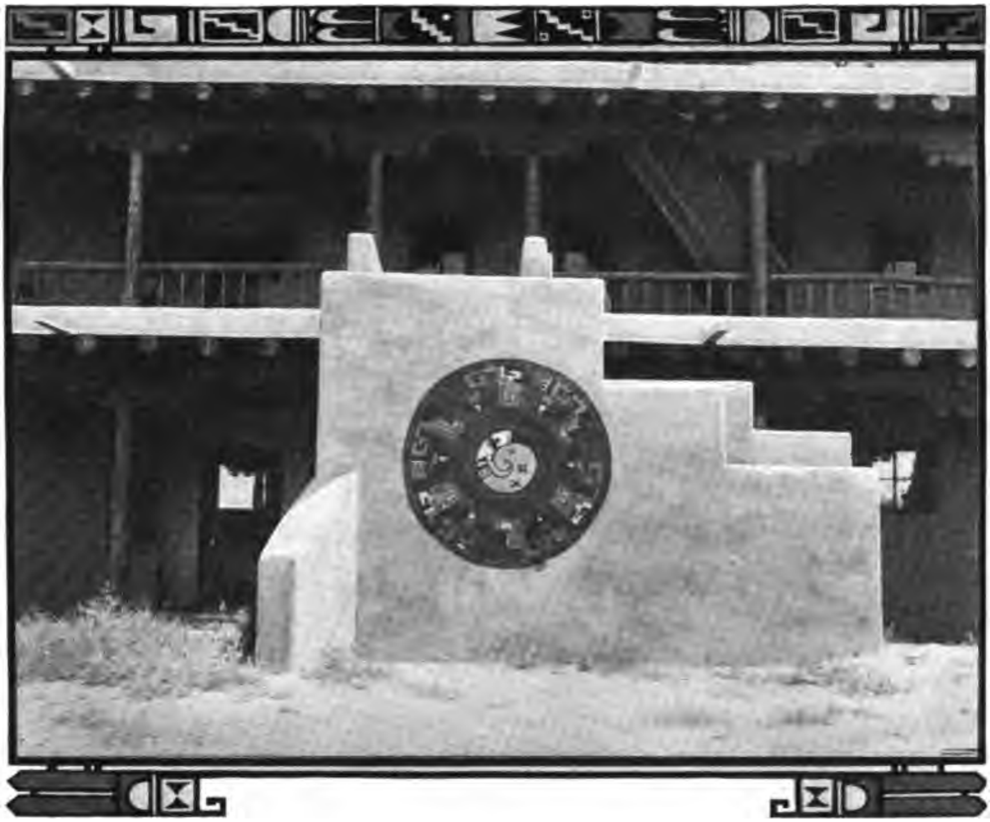

THE ENTRANCE TO HOKONA—THE WOMEN'S DORMITORY.

leading to the roofs from the outside. There are no windows in the first stories of these homes, but in the roofs there are manholes, down which the red-skinned householder enters after climbing to the roof and pulling the ladder up after him. Thus he is safe from all his primitive foes. Ladders exactly like those in use at Zuni, Acoma, Hualpi, and other pueblos, lean against the walls of the college buildings, but modern stairways inside lead from story to story, while the ladders merely give an air of realism to the whole setting.

An exact imitation of an Indian oven, a curved arch of sun-dried adobe, is placed on the roof of each of the dormitories, but in this case the oven covers, not the black bread of the Indian, but a reservoir, whence water runs through a unique, modern sun-heater to the bathrooms below. When the sun is off duty, hot water and steam heat are supplied by a central heating plant, also situated in a structure planned after the manner of the pueblo houses.

The buildings, as might be imagined from the generally square ground plan of this type of Indian architecture, are in the shape of irregular rectangles. Each of these, and there will be two, separated by a 50-foot, tree-lined avenue, when the plans on the campus are completed, will consist of about six buildings, so connected and so built under one roof as to appear to be one building.

Three and one-half stories will be the height of the highest part of this communal house; from this the square rooms will slope down to one story. The higher part will be used as kitchen, dining room, laundry, storerooms, etc., while flanking it on either hand will stand the two dormitories already erected and described above. L-shaped buildings will fill out the general plan at the rear corners of Hokona and Kwataka. Inside the entire structure will be a spacious patio or

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placita, which will be devoted to flowers and foliage plants indigenous to the desert in which the pueblo cities were built.

To give some idea of the magnitude of the work which lies before President Tight and his assistants, it may be said that the highest part of the pueblo buildings will extend seventy feet into the air, while the distance around the outer walls of each will be a trifle more than 1,000 feet. The avenue running between the two pueblos is bordered by a fifteen foot sidewalk, and the parkway between walk and curb is planted to weeping willows and cottonwoods, fast-growing trees which will be suffered to remain and furnish shade until the hardier trees which have been planted in between shall have attained a sufficient height to supply abundant shade.

Inside the buildings the Indian scheme of finishings, furnishings and decorations has been carried out in perfect accord with the exterior of the buildings themselves. Electric lights have superseded, it is true, the cedar and juniper torches of the Pueblos of Coronado's time, but the incandescent globes hang from electroliers made of these woods and carved in the shape of the swastika, that armed cross common to all tribes since history began, but over which sentimental ethnologists have tried to hang a cloud of mystery.

RECEPTION ROOM IN HOKONA.

Indian decorations of picturesque design, largely taken from the primitive friezes and mural decorations of Sikyatki, ornament the walls of the university buildings. Most of these are adaptations of the forms of nature as they appeared to these people of the ancient pueblo, and include trees, lightning, wind symbols, the rainbow, and numerous birds, beasts and reptiles—of fishes they, of course, knew little or nothing,

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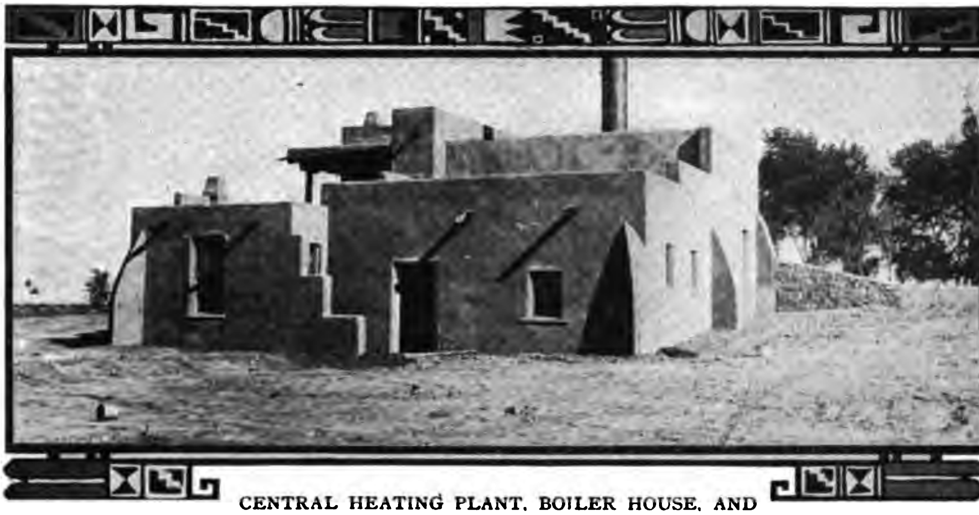

CENTRAL HEATING PLANT, BOILER HOUSE, AND FUEL BINS, ALL BUILT ON PUEBLO LINES.

and their art is lacking in representations of denizens of the waters in any form. Many quaintly beautiful decorations from the interior of caves and cliff dwellings have also been reproduced here, until the inside walls and ceilings of this modern pueblo are fast becoming genuine storehouses of Indian art.

Indian rugs, pottery and baskets, together with weapons of war and arms of the chase have been gathered together by faculty and students, all of the latter having ardently caught the spirit of Indian decoration and entered with zest into the carrying out of the pueblo idea. These relics of a departed race are all genuine and not of the class made for sale to tourists along the railroads, so that they, too, have a value as signboards on the road of man's knowledge of man as well as mere decorations. On festive occasions, the pueblo buildings are deco-

CAMPUS VIEW SHOWING THE DORMITORIES HOKONA AND KWATAKA.
They will eventually be united into one large pueblo.

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CHAPTER HOUSE OF TRI-ALPHA ESTUFA FRATERNITY.
The estufa was the Indian council chamber, entered from the top. It had no windows.

rated with strings of red chiles—peppers which are always to be seen hanging out to dry on the walls of the Indian communal cities. Coupled with these are the pumpkin jack-'o-lanterns of our boyhood days back on the farm, also a favorite ornament, during the harvest season, of the pueblo houses.

Plans for the complete pueblo scheme, starting with the two dormitories as a unit and working up to the group of buildings, all apparently one, are the fruit of the brain of Dr. Tight, president of the university and one of the foremost archeologists and ethnologists in the United States. Supplementing his efforts, comes Mr. E. B. Cristy, the architect, who made a personal study of the pueblo communal houses for some time before beginning work on the educational institution's home. Existing laboratories, class-rooms, halls and other buildings will be completely remodeled to follow the new conditions, and the entire campus will be redressed in a landscape scheme which will produce a scene identical with that in which many of the ancient Indian pueblos stood.

One of the unique features already installed on the campus is a huge sundial, a present to the university by one of the graduating classes. Bedded in a large pile of boulders, in the crevices of which have been planted cacti and other desert growths, this sundial is accurately set up, and bears on its face this motto: "Short the day; great the work. I tarry not for the slow." On the campus, too, is located the Estufa, a low, brick-walled, cement-covered building, designed for use as a fraternity house, rather than as a council chamber, for which the estufas of the old pueblos were used.

Following faithfully the plans of the Indian originators of the estufa, this unique building is entered through the top, having neither windows nor doors in its sides. Seats of Indian design, also, have been scattered about the campus together with other ornaments carrying out the general aboriginal plan.

In addition, however, to being unique in design, these pueblo reproductions serve an additional and two-fold purpose. Owing to their peculiar, thick-walled construction, they are cool in summer and warm in winter, while they are the most easily added to, as increasing university attendance demands more room, of all styles of architecture known to modern man. In this last feature probably lies the reason of their choice by the Pueblos for their homes. As the tribe grew larger it was small trouble to add here a room and there a room as occasion demanded. Thus it is with the

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University of New Mexico: In addition to preserving for all time the architecture and the relics of the fast-vanishing people, these pueblo buildings will serve freshmen, sophomores, juniors and seniors better as school homes than any other type which architectural ingenuity could possibly devise.

DIVINING-ROD STILL MYSTIFIES

By H. G. HUNTING

THE enthusiasm with which men have written to disprove and discredit the claims of those who relate successful experiences with the divining-rod, for the finding of hidden underground springs, has served to create a rather unusual interest in the subject. It is somewhat like shaking a red rag at a bull to raise the subject again, before the heat of a recent discussion has fairly cooled, but a new theory and a new account of success have come together from France, both of which are worth relating.

That springs are actually found, and with surprising frequency, by men who use the divining-rod, is a fact that cannot be disputed. But whether it is the rod or the man that finds the spring is the open question. The Frenchmen claim that the man is the sensitive medium upon which the unexplained influence works, while the rod is but a means of expression which shows the effect. Both observers and the workers with the rod, state that only those to whom the gift is given naturally, can hope to succeed with the divining of springs, and claim that the criticism and ridicule that is turned upon them is due to the fact of failures where the gift is absent.

Reproduced herewith are a number of photographs of a genuine spring-finding

TRACKING WATER ACROSS A FIELD.

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experiment which was recently carried on before credible witnesses in France, and which was successful. The sourcier, as the French call the experimenter, used in this case a green rod, as may be seen from the photograph of the cuttings. Operators differ in their preferences, as to what sort of a rod to use. Some employ a special species of wood, some demand young, green shoots, and others are satisfied with dry ones. Oak, elm, hazel, ash or privet are used. Generally, the rod is cut in the form of a Y, with the

CUTTING RODS.

parent branch trimmed short—from one to two inches in length—while the diverging twigs are left about a foot or fourteen inches long. The size of the twigs themselves ranges from that of a lead-pencil to that of an ordinary clothes-pin in diameter and they are usually chosen with branches diverging at angles of from twenty-five to fifty degrees. Some workers build up rods of their own, using two different species of wood, one for the head and the other for the branches. Some even use rods made up of wire, often very thin wire.

The material, whatever it may be, once chosen, the operator grasps the two boughs, one in each hand, holding his palms upward, and walks slowly over the ground where he hopes to find water. In the case pictured herewith, the experiments were extended over a considerable territory, and were witnessed by several persons. Naturally, the curious are attracted by the proceedings. If there is any underground water in the neighborhood, the moment the rod and holder come within its influence, the watchers are rewarded by the queer performances of the forked stick. The head, or point of the crotch, which is pointed earthward, at first, tends to rise more and more, compelling the hands of the operator to turn with it. Incredulous spectators may object that it would be easy to feign, if the operator were so inclined, and so would it be. It would be easy to raise the head of the fork for the sake of the mystifying effect on the onlookers. But what would this kind of deception avail, when the

SELECTING THE INSTRUMENT.

test to prove the presence of water in the vicinity is applied? Moreover some observers who have actually been allowed to hold the rod themselves, state that they have felt unmistakably the inclination of the rod to move of its own

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THE UNDERGROUND CURRENT TAKES THEM OVER A FENCE.

accord, and with a vigorous, and decided movement.

This last statement would tend to disprove the theory that it is the man and not the rod that is sensitive to the influence of the hidden spring, but the sourcier claims that it is simply a matter of the degree to which the rod will be affected in various hands. When the professional holds the rod, the efforts of muscular men holding his wrists have been unavailing to prevent the movement. In some cases the rod has described a complete turn from its initial position to the vertical despite efforts to prevent. And if there is fakery in the business it is well covered and exceedingly effective for the ordinarily credulous by-stander to take note of.

WHEN WATER IS BELOW, THE ROD TWISTS UPWARD.

The French theory that there are persons endowed with stupendous hydric sensitiveness seems to be borne out by the facts. Witnesses state that they have seen the rod move so violently under the influence of an underground spring that it actually revolved several times, twisting the twigs to the breaking point. Dr. Vigen, an eminent authority on the subject, says, however, that the most apparently sensitive of the sourciers cannot always be relied upon, as other than hydric influences seem to affect them. Whether this is intended in facetious

THOUGH THERE IS WATER BELOW THE ROD DOES NOT RESPOND, FOR THE OPERATOR IS NOW STANDING ON GLASS BOTTLES.

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OPERATOR HOLDING ROD BEHIND HIM STILL GETS ITS INFLUENCE.

spirit does not appear, and the Doctor cannot fairly be charged with joking.

As to scientific explanation of the phenomenon, there seems to be none at present. Neither is it proved that nervous or hysterical persons are more susceptible to the influence of the underground waters than others. Persons of all ranks have made the experiments and representatives of classes high and low have been successful, sometimes to their own great surprise. M. de Mortillet, the well-known anthropologist, has been among the experimenters, and senators, monks, one bishop, peasants and children have all had a hand in them at one time and another. M. de Tristan and M. de Morogues are among the sourciers who have tried to demonstrate the scientific causes of the phenomena observed. They have worked upon the theory that the underground springs and streams generate electric currents of peculiar kind which affect only specially endowed persons. But this theory falls down before the experiments of Dr. Grasset, of Montpelier University, who used exceedingly delicate electrometers in an effort to discover such currents over known springs and water-courses, and was unable to show a trace of effect upon them from the underground waters.

Dr. Grasset believes that the ability of the sourciers to find underground springs proves the existence of a faculty belonging to a class of physiological feelings forming what he calls *psychisme inferieur,* the study of which is just beginning to attract the attention of the scientific world. Whatever the exact nature of that power, call it instinct or a physiological propensity, it seems to matter not to the divining-rod which continues to revolve—and to discover springs.

The photographs here reproduced were carefully taken, during these recent experiments in France. Perhaps the earnestness of the participants in the experiments, which is unmistakable, will convince some of the scoffers that the

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men who are carrying on the trials are at least believers in their own theories. It is a curious fact that this experimenter found that standing on glass seemed to affect his ability to find underground water, though it is claimed by the scientists that electricity has nothing to do with the indications of the rod. But, over one point where water was known to exist underground, the rod behaved in its best divining manner till the operator stood upon a couple of bottles, and then it desisted from all efforts to turn its root skyward.

FOLLOWING A SUBTERRANEAN WATER-COURSE

HOLDING WRISTS TO SHOW THAT UPTURNING OF ROD IS NOT A MUSCULAR TRICK.

The power of the pull—or rather the push—upward, is illustrated in the picture showing the measuring of it by means of scales. It was found that the force of the upward lift of the rod varied under varying circumstances. Sometimes it runs as low as four pounds or less, but at others it is as high as six pounds or more. The instruments used to measure the tug, having no imagination, and not being subject to superstition, have some authority and deserve to be credited with their records. They necessarily tell the truth about the effects which the rod produces upon them. It would be hard, admittedly, for the operator to produce an upward pull of six pounds upon the rod and so upon the scale, by muscular movements, without detection by the onlookers. A careful study of his manner in action and of the record of the camera afterwards, reveals nothing of the sort. He seems, in fact, to be resisting the movement of the rod, which appears to be acting in spite of him and of the pull from the scale-hook.

The fact that this sort of experiment has been tried over and over again, and that the results have been similar in the vast majority of cases, seems to prove that there is something in this water-divining that is not all fakery or imagination of credulous people. There is something of the showman about some of the men who have made public demonstrations of the work with the rod and much prejudice has been created by some of them through the secretiveness and buffoonery in which they have indulged, but men are finding underground water with the rod, and use is

THE ROD TURNS UP IN SPITE OF PRESSURE ON WRISTS.

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being made of their successes, so that cavilling is not justified. If there is much fakery, at least there is enough of the genuine to warrant serious attention.

A record of the experiments which have been tried in Germany has been printed in the TECHNICAL WORLD MAGAZINE. They attracted wide attention at one time and much was printed about them. It was acknowledged by the Germans that the working of the rod was not to be accounted for on known physical laws. They seem to have been as much in the dark as to the real nature of the influence the rod feels as are the French and their observers. Criticism is also free among the scientists of the Kaiser's country who have tried and failed with the rod.

WHEN THE DIVINING-ROD IS HELD CLOSE TO A WATCH, THE HANDS TURN FASTER.
In one trial a gain of 8 seconds was made in 28.

TESTING PULL OF DIVINING-ROD.
It required six pounds to overcome the resistance in this instance.

Herr Von Bulow-Bothkamp is one of the best known workers of the rod-wonders in the German realm. He has had genuine success and those who have seen his work have been satisfied that it is not fakery. He is a man of standing as a searcher after scientific truth and the men who have followed him in his experiments deserve attention. He has not only found water in places where it was not suspected to exist in quantities, but he has determined its depth below the surface and has proved his findings by uncovering valuable supplies.

As was recounted in a former article in this magazine, the German Emperor sent Herr von Uslar to the German Southwest African colonies, and he found water for the people there with surprising ease, by means of the rod upon which he depended. Hundreds of springs were discovered and developed and his work was of great benefit to the communities in which he made the effort to locate water supplies.

Several mechanical contrivances have been devised for the water-finding purpose and two or three of them have recently been described in these pages. But about none of them clings quite the same interest the rod seems to claim, because of its suggestion of the mysterious.

Perhaps the time may come when the prospector in arid regions may carry with him the divining-rod.

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INTERIOR OF ROOM WHERE MEN ARE TRAINED IN RESCUE WORK.
Two of the rescuers are carrying the "asphyxiated" man, while a third is giving oxygen treatment to another.

EXPERIMENTING WITH DEATH

By ROY CRANDALL

DR. JOSEPH HOLMES, Chief of the Technologic Branch of the Geological Survey, is so firmly of the belief that it is not good "business policy" to waste 3,125 men in coal mines each year that he has fought and won a battle which will give him the right to save a handsome percentage of that annual "wastage," and to that end he will establish rescue and experiment stations in the catastrophe zones or calamity belts of the continent just as soon as appurtenances and equipment can be prepared.

America has ever been backward in man-saving, as indeed she has been backward in the conservation of other natural resources, but in the belief of the wide-awake official who is now planning to make the coal miner a less hazardous life insurance risk than he has been during the past few years, the time has arrived for coal mine operators to answer the question: "Can we longer afford to let you kill 3,125 men each twelve-month, with conservative European life insurance companies quoting

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each and every man at a valuation of $10,000?" And, of course, there can be but one possible answer to this. The waste of man has got to stop because good business reasons demand it. On the very face of the problem the lack of wisdom in present methods is plainly to be seen, for at the above quotation the cash value of the army of explosion victims would total $31,250,000 annually—a five per cent income on $625,000,000—and that's a goodly sum of money, even in these days of prodigious tasks and prodigal wastes. Because those who employ the men "who go down in the earth for coal" are prone to figure in dollars rather than in human sympathy, that cash appraisal of a year's coal mine victims is made: but as some deplore that red blood loss on grounds of simple humanity, and think of the crepe-decked doors of the squalid cabins of

OBSERVATION HOUSE.
Miners stand within this protection and watch explosions of coal dust and fire damp in galleries 60 feet away.

MEMBER OF GOVERNMENT RESCUE CORPS, EQUIPPED TO ENTER MINE WHERE DISASTER HAS TAKEN PLACE.

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the miners, it is here set down that if skill and care can reduce the ghastly annual death rate of 4.86 per 1,000 it is high time the reduction take place. The plans of Dr. Holmes merit commendation and warrant haste.

True there are extenuating circumstances—the same ones the stand patters advanced when urged to save the forests, the mines, the waterways and the soil, but those were the excuses of a prodigal—a spendthrift. The stand-pat cry has ever been: "We're too big and too rich to worry about trifles. If the people want wood let 'em have it. There's plenty more where that came from. If they want to waste 250,000,000 tons of coal in a year in taking out 250,000,000 tons let 'em do it. Guess there'll be all we need. Don't bother us with complaints and all that stuff about economy and conservation. We're young and strong and rich. Let the measly little two by four countries of Europe attend to such things, but for Heaven's sake stop being a piker."

And while that exact statement was never publicly made by a coal mine operator in referring to coal mine disasters and the human victims the stand-pat policy has long endured. The miners have been given no more consideration by those employing them than the American forests received at the hands of those who now realize that the life of the very nation depends upon them.

If faulty construction or an explosion occurred in a mine the bodies of the dead were removed and more miners were at the mouth of the shaft early the next morning to risk their lives that dividends might not fall off. Men were ever cheap—far cheaper here than in any other country where coal is mined, for despite a boasted additional enlightenment and a broader humanitarism, America's coal mine operators have standing against them a death rate almost four times as great as that of any country in Europe.

It's true that more coal is mined here than in other lands; that more men are employed in the hazardous toil, yet the horror record stands against the production record with a longer lead in miners' deaths than in tonnage, and the pity of it, and the shame of it lies in the fact that 75 out of every 100 men killed

FIFTEEN SECONDS AFTER AN EXPLOSION OF COAL DUST IN THE EXPLOSIVES GALLERY.

ONE PITIFUL SCENE AT THE TERRIBLE MONONGAH, W. VA., DISASTER.

are the shattered or the smothered victims of carelessness or neglect and that their lives were sacrifices to greed or ignorance, or perhaps to both.

It was only after study and research had made plain the truth of the above bitter indictments that Dr. Holmes took up the fight that has resulted in appropriations for rescue and experiment stations. The first one was opened on the arsenal grounds at Pittsburg some few months since. It proved soon after its creation that experimental work and convincing demonstration meant a saving of lives and the request for funds for additional stations followed as a natural sequence.

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WIGAN COLLIERY DISASTER—WAITING FOR NEWS FROM BELOW.

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Of some of the work done at Pittsburg some paragraphs will later follow. It is proper at this point to locate the planned prototypes of that worthy parent. Of these new stations there will be four for a starter, and they will be located in the principal coal fields of the country; as near as possible to the gruesome points where calamities are most likely to occur. One will be at Urbana, Illinois, conducted largely by the University of Illinois, and the engineers and scientists connected with it will do all in their power to ameliorate conditions at the mines in Illinois, Indiana, Michigan,

THE EXPLOSIVES CHAMBER, WHERE EXPLOSIVES ARE TESTED IN PRESENCE OF COAL DUST AND FIRE DAMP.

THE ONLY PHOTOGRAPH OF A MINE EXPLOSION EVER TAKEN.
Disaster at Stanford Merthyr Colliery, New Castle, New South Wales, in 1907. The photographer had focused his camera on the little wisp of smoke, coming from the burning mine at the right. At the instant of exposure, a great column of smoke burst forth. It was an explosion, in which several men were killed.

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Iowa, Northern Missouri, and Western Kentucky.

Another station at Raton, New Mexico, will take care of the mines and miners in New Mexico, Colorado, Utah, Wyoming, and Montana. The largest coal output in New Mexico and Colorado comes from the Trinidad field, which is immediately accessible to Raton. There is a possibility that another station will be located in that huge section—at Salt Lake if the appropriations will warrant it.

In Oklahoma, a short distance from South McAlester, there will be established a third, which will take care of the coal fields of Oklahoma, Arkansas, and Southwestern Missouri.

Owing to the wealth of coal mined in the South and to its plenitude in three separate states no decision has been reached as to the location of the station, or stations, which will be established there. One, or possibly two stations will cover the coal fields of Alabama, Tennessee, Virginia, Eastern Kentucky, Georgia, and southwestern West Virginia. There are urgent demands from many localities for the station; one of the strongest appeals coming from the University of Tennessee at Knoxville. Inasmuch as that institution has a mining course there are strong reasons for favoring that location, but Birmingham, Alabama, and Lexington, Kentucky, also have advanced strong claims.

It has already been decided that Mining Engineer George S. Rice will have general charge of all mining inquiries at the various stations, and J. W. Paul, former state mine inspector of West Virginia, will have supervisory charge of all rescue work, but the term "rescue work" requires a bit of enlargement, for while the stations are termed "rescue stations" their rescue functions will be closely confined to demonstrating methods.

Therein lies one of Uncle Sam s many aggravating anomalies. The nation can show how rescuing may be done but it can't do any rescuing itself. The skillful engineers in charge must save through teaching. Theirs will be the privilege of showing mine bosses and miners how to use the most approved apparatus for mine rescue work and to tell what explosives are the safest. There is a reason for this. This, it will be remembered is a diplomatic — a commerce-coddling nation, which therefore confines the activities of its employes to the conducting of experiments; the assembling of information; the dissemination of knowledge and the exhibition of appliances.

In the first instance the mining scientists will seek to prove to the mine operators that they are wasteful of their men and that it is needless to kill more than one out of every thousand each year. It will then further show them that they kill because mines are not kept free from fire damp, though proper precautions would rid the mines of that deadly gas; that rescue parties if equipped with oxygen helmets could safely enter mine chambers wherein the fatal gas was smothering their unconscious comrades and drag them to safety; that so many so-called "safety" explosives were, in fact, most dangerous, and that, contrary to the stubbornly maintained beliefs of many mine owners, coal dust under certain conditions is as explosive as dynamite.

That was conclusively proved a few months ago at the initial experiment and explosive station at Pittsburg. In fact the work done there quickly gave convincing proof that conditions could be bettered and lives saved through study and demonstration. The demonstration which first brought that fact to the attention of the mine owners lingered in their recollections for a long time, for it was spectacular to a pronounced degree. One of the principal features of the big plant on the arsenal grounds at Pittsburg is the so-called explosive tube—a boiler plate cylinder 100 feet in length and six feet in diameter. Along the top of the contrivance, which is to all intents a mine tunnel, are a set of safety valves, or hinged doors. The force of any explosion in the cylinder forces these up so that the violence of the detonation loses itself in the outer air. In one end of the tube a cannon has been installed and from it charges of various explosives can be fired directly into the great tube: the firing being done by an electrical device operated from the observation house sixty feet away. On the

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day of the first demonstration a quantity of anthracite coal dust was pumped into the cylinder and the assembled mine operators who had maintained that it was non-explosive smiled sardonically when no explosion followed the firing of a charge of dynamite into it. Then

MEMBERS OF THE RESCUE CORPS, EQUIPPED TO ENTER A "RESCUE STATION."

bituminous dust was used. An instant after the cannon had been fired that portion of Pittsburg fairly rocked with the force of the roaring disturbance. The safety doors flew back and pounded on the top of the cylinder; sheets of flame and clouds of smoke followed and from all directions came the tinkling of breaking glass, for windows nine hundred feet distant were shattered.

Following came tests of various explosives now widely sold and in well nigh general use. Many advertised as non-inflammable and non-explosive were shown to be exceedingly dangerous while others, less flatteringly described by their makers, were found to be far less liable to bring death to those using them.

It is a moot question which phase of the experimental and rescue work will bring the greatest benefits, but it is already certain that many lives will be saved solely because of these tests of various explosives, for they will ultimately bring about a standardization of the powders to be used, and when the safest has been found and been placed in general use the number of accidents will materially decrease and there will be a two-fold gain: lives will be saved and coal will be saved. In the past, premature or ex-

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RELATIVES AND FRIENDS AT THE MOUTH OF THE PIT, MONONGAH MINE DISASTER.
356 lives were lost in this explosion, the greatest mining disaster in America.

cessively heavy shots or explosions have caused cave-ins which have resulted in the losses of hundreds of millions of tons of coal.

Already good results have followed from those first explosive tests. Many mine operators and mine superintendents have since given orders that only certain specified explosives shall be used and that before a "shot" is fired, the coal dust in the neighborhood of the prospective discharge shall be wet for a radius of a number of rods.

Realizing, however, that prevention is but a percentage of his task Dr. Holmes planned other work of a more spectacular nature. His rescue demonstrations are worthy of stage presentation for they are melodramatic to a startling extent. In his demonstration room one may see fac simile reproductions of shattered and sunken mine levels with unconscious miners lying senseless in the wreck and ruin—with clouds of well nigh impenetrable smoke swirling about them and with shattered timbers blocking the paths to safety. Then will be seen the arrival of other miners with heads covered with huge oxygen helmets as large and hideous as those worn by submarine divers. Into the smoke, over shattered timbers and through narrow tunnels, these helmeted heroes make their way to the sides of their unconscious co-workers; place them on stretchers or toss them over brawny shoulders and bear them out. There is dash, danger and heroism in the demonstrations, and they form a series of startling pictures when seen through a plate glass wall—for they all take place in an enormous glass room—from the outside of which the operators and scientists may observe the rescue crews at their startling studies.

Into this room by powerful pumps, poisonous gases, smoke or fire damp can be forced; or the air can be withdrawn and a vacuum created. During the month of February some vastly interesting scenes were witnessed from the outer observation chamber. With great care a section of a crushed-in mine filled with fire damp was constructed. Into this

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scene of wreckage a rescue crew equipped with the helmets went. Scattered in various portions of the miniature mine dummy figures representing unconscious miners had been placed, all being life size and averaging 160 pounds in weight. The efficiency of the life giving helmets was well established on this occasion, for some of the men remained in that polluted atmosphere for an hour and worked as well as though in the fresh outer air. They carried the dummies around and around the room on their backs and finally clambered up narrow ladders with them and dragged them to places of safety through dark narrow passages scarcely high enough for them to wriggle through on hands and knees.

While these dramatic scenes were taking place mine owners and miners—two of the latter with their helmets on their heads in case they might have to dash in and rescue the demonstrators—watched the work and all were enthusiastic in praise of the apparatus and of the skill and intelligence of the men. All conceded that if such men, so equipped, had been on hand at the various mines in which catastrophes occurred during the years 1907 and 1908 the mortuary records would not form so startling a condemnation of American mining methods as they do today.

In each of the experiment stations now being prepared similar demonstrations will be made and experts will be on hand to show the miners how to use the helmets; how to enter a mine when it is filled with the deadly fire damp; how to drag or carry out such of their comrades as have been overcome, and how to resuscitate them when they have been brought to the surface.

It is the hope of Dr. Holmes that all mine operators will co-operate to the extent of detailing men to take these lessons and, when they have become expert, to hold them as rescue squads at the mines. If that is done beneficial results will follow, for the statistics of other lands prove that deaths in coal mines are largely preventable. In fact in every country but this the number of fatalities has been reduced materially in the past few years. When one learns that in the seventeen years from 1890 to 1908, 25,965 men were killed in American mines it is apparent that the time for the conservation of miners has arrived. In the past few years European countries have made material gains in this humanitarian work. The standardization of the safest explosives was first taken up and in every country it quickly reduced the death rate to an appreciable extent. Belgium, Prussia, France, and Great Britain especially went to the front in this work. And those countries now know that rescue knowledge and training will bring about still another percentage of gain in life saving. In each of the countries named these studies have resulted in a lowered death rate, but in America the annual percentage has been on the increase. Belgium worked slowly but accomplished much, for the statistics of that frugal little land show the following:

Miners killed per 1,000 in 1831.. 3.19
Miners killed per 1,000 in 1906.. 0.94

In Great Britain the death rate in 1891 was 1.50, but it had been reduced to 1.28 in 1898.

In Prussia it was 2.66 in 1861 and but 1.30 in 1904.

The best showing of all is made by France. In 1901 the rate was low at 1.03, but in 1905 it had been lowered still further to 0.84.

The records of this prodigal and thoughtless land are not so flattering. In 1895 the coal miners were being killed in American mines at the rate of 2.67 per 1,000. In 1905 the rate had increased to 3.53 and in the gory year 1907 it stood at the startling rate of 4.86.

All these things the skillful men of the Technologic Branch now know, and it is through an amplification and a wider dissemination of their knowledge that they must work to gain ground. In that manner alone may they strive to conserve the greatest of all national and natural assets—mankind. The nation has framed laws for the preservation of the forests because man needs wood. It has legislated and poured out millions for the betterment of waterways because freight may be carried in barges; it has planned, though feebly, for the protection of its land, but man is left unguarded. Coal mines may slaughter him and go scathless; railroads may vivisect him by thousands and pay triflingly, if

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at all, for the privilege of this heartless, wanton destruction.

And therein lies the trouble in this struggle to save him—the weakness of the nation which cannot officially intervene between capital and that on which capital waxes fat.

Those men of intellect who study and delve to mass together knowledge for the betterment of the race learn of great wrongs and discover plans whereby those wrongs can be speedily righted, but barriers are before them which they cannot surmount. Their duty ends with the diagnosing of the ailment and the preparation of a prescription for its cure. It has been especially so in the coal mine ailment, but that has been studied with care and the study has shown that greed and competition have made the men who own mines callous to conditions which are shameful in the extreme. As a result thousands of men have died in agony hundreds of feet below ground, who today would be sturdy workmen if proper precautions to safeguard them had not been neglected because such precautions would have cost money and lowered dividends.

As dollars grew dearer lives became cheaper. In 1906 the coal mine horror list showed 2,092 men killed and 4,800 badly injured. In 1907 the death list had swelled to nearly 3,200, and that of the injured to 5,300. In 1908 there was a slight betterment because when the results of some of the earlier experiments at the Pittsburg station were brought to the attention of the principal operators, a number of them made changes in the methods of taking out their coal.

The showing, however, was sufficient to cause European experts from England, Germany, and Belgium who were here in August and September of last year to express surprise at the laxity shown in nearly every mine inspected and to draw up most minute recommendations for proper "shot-firing" and for the dampening of coal dust in all mines where shots were to be fired.

Soon after the arrival of these distinguished men—Victor Watteyne, Belgian Inspector General of Mines; Carl Meissner, German Councillor of Mines, and Captain Arthur Desborough, Great Britain's Royal Inspector of Explosives, they were handed a list of the principal disasters for the previous few months and in a number of instances they made inspections of the mines in which the disasters had occurred. They were horrified by the record of December, 1907, when the lives of 700 men were snuffed out in four appalling disasters—the one at the Monongah mine in West Virginia where 356 were killed, being the greatest in the history of the country. The Dorr mine horror in Pennsylvania followed with 250 deaths. Sixty-one men were killed at Yolande, Alabama, and 32 at the Naomi mine in Pennsylvania. In that state alone 1,514 men were killed during that year.

The next month ushered in the year 1908 and also the horror at the Hanna mine in Wyoming wherein 70 were killed. This was a particularly heartrending case, inasmuch as 65 of the 70 formed a rescue party which had volunteered to go after the five men who were in the mine when it exploded and became on fire. The party had reached the lower levels when a second explosion occurred. Sheets of flame rushed from the pit mouth and told the story of additional deaths. Inasmuch as that was the third calamity that had overtaken the ill fated Hanna mine the owners feared to tempt fate further and they ordered the mine sealed up for all time. The dead or dying seventy were sealed up in the doomed property.

Some short time thereafter there was a disaster at Lick Springs, Virginia, wherein 50 men were killed. The newspaper readers of the land were spared a description of that horror only because the world stood aghast in face of a greater one. Messina lay in ruins that day with her 100,000 dead to grieve for, and the editors who knew of the fate of the 50 miners in the pit of death at Lick Springs tossed the paltry item into waste baskets that more column space might be available for the more terrible story from stricken Sicily.

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THE FORESTER'S WORK IS THE BASIS OF ALL REAL CONSERVATION OF NATURAL RESOURCES.

REAL CONSERVATION OF OUR RESOURCES

By EDWARD G. ACHESON

President of the American Electro Chemical Society

THE age is thoughtful and progressive. At least we think it is. It speaks well for the people of the United States that citizens of this country were first to conceive the advisability of a conservation movement national in its character. The scope and possibilities of such a movement are astounding, and we must needs be exceedingly careful in order to make certain that our efforts are not misdirected. The question of the real conservation of the resources of any country is one of mighty moment, and it would not be remarkable if the cursory review of opportunity so far made has not revealed to the fullest extent the richness of our awakening. In the infancy of the movement, we must not feel that the curtains have been fully drawn. Rather let us believe and feel, as the American people have always felt, that better things and brighter prospects come as the result and reward of honest activity and toil. Let us not only feel that we can conserve what we have, but actually earn additional resources by our abilities that will make for the common good of all. To do this, we must study the question of conservation and indicate to ourselves, as well as to others, what true conservation means.

EDWARD G. ACHESON.

When President Roosevelt declared from the stage of the Belasco Theatre at Washington to the conferees of the Joint Conservation Conference, there assembled December 8th, 1908,

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that we, the people of the United States, were the first to take a national attitude toward the conservation of natural resources, a thrill of pride passed through the writer in being one of this great people. A profound sense of pleasure was felt in the realization that we were now great enough to call a halt in the heedless consumption of the world's stock of necessities; rich enough to construct great works for the attainment of that end; scientific enough to create artificial duplications of the natural and add to the store of materials nature has provided for man's use, and lastly humane enough to devote some thought, work and resources toward providing for our unborn posterity.

At the succeeding sessions of the conference, there was a double definition given to conservation of natural resources: the preservation of these valuable assets of the country for posterity, and again the energetic, although conservative, utilization of the world's good things by the people of today. Much stress was laid, for instance, upon the great advantages of a national movement for the use of our natural resource—water, for the carrying to and fro of the internal commerce of the country. It was considered advisable to issue vast sums in bonds, that our children and our children's children might participate in the obligations involved in this great work of, as it was stated, saving us some millions of dollars annually in transportation, these great waterways remaining of course for these children to enjoy and profit by in return for their bond payment.

A matter of much regret and surprise was the failure of this great representative body of our citizens to devote some time to the actual conservation of our resources, with the one exception of the forests. To fail to grasp the grand opportunity of this great nation, the first to suggest the movement, to lay at least the foundation of a structure that will

GREAT FALLS OF THE MISSOURI, MONTANA.
Just one example of our inexhaustible water-power, which can help to save our exhaustible carbon.

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A CHEMICAL PLANT AT NOTODDEN, NORWAY, WHERE NITRATES ARE TAKEN FROM THE AIR AS A FERTILIZER OF SOILS.

be erected by some nation, to last as long as life exists on earth, the real conservation of nature's exhaustible resources by the scientific use of her inexhaustible ones, should surely be a matter of regret and mortification.

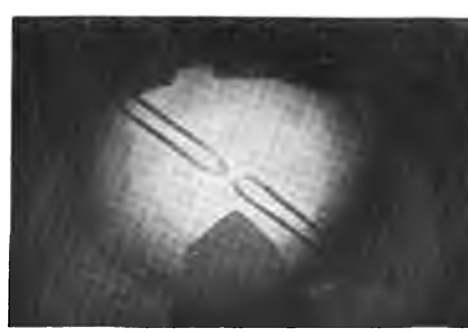
To fully utilize our natural inexhaustible resources should and would be a matter of extreme pride to the present and future gènerations of citizens of the United States, but to do that and simultaneously conserve our natural exhaustible resources would be an example to the entire civilized world, and to be the first people to do so would, for all time, sustain the American people in their present position of progressiveness.

By suppressing selfishness, corporate greed and personal aggrandizement, we are today capable of building as no people have built, and this without permanent cost. We have within our broad country all necessary for the carrying to fruition such a grand project, by the cooperation of bond issue, our inexhaustible resources, and the world's present scientific knowledge.

The executive department of our government has pledged itself to the issue of bonds for the development and utilization of our natural inexhaustible resource —water. Let this development and utilization be broadened, in fact, commence with the construction of great water powers, with which the electrochemist may produce substitutes for, and, in some cases, improve upon, our natural exhaustible resources, and, in other instances, produce within our country products which we are now buying abroad at an annual expenditure of many millions of dollars.

This last mentioned condition is strikingly illustrated by sodium nitrate, the commercial product more generally known as Chili saltpeter.

The world has been depending on Chili saltpeter for the nitrogen essential



THE DISC OF FLAME PRODUCED IN THE ELECTRIC FURNACE, AT THE NOTODDEN WORKS, USED IN TAKING NITROGEN FROM THE AIR.

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for fertilizers and explosives. It is mined only in Chili and Peru. The world's consumption, during the year 1907, amounted to 1,662,000 long tons; the imports into the United States exhibiting a very steady increase from 147,495 tons in 1898 to 364,610 tons in 1907. During the same period the price increased rapidly from $15.58 in 1898 to $40.71 per ton in 1907, and during the decade the total value imported was $80,916,224—a very large sum of money to send out of the country. But let us examine the prospects for the future.

It is fair to assume that the consumption of nitrate will continue to increase for the next twenty years, as it has during the ten years just passed, and if that be the case, we have the following remarkable figures before us. The importation in the year 1926 will be 798,840 tons, and the average annual importation for the twenty years ending with that date will be 581,725 tons, giving as a total amount imported 11,634,500 tons. As will be seen from the statistics of the past, the value per ton has risen in a remarkable manner, due largely to the nearly exhausted condition of the Chili deposits, but in view of the fact that electrochemistry has mastered the problem of fixation of nitrogen, it is not at all likely that the price will continue to materially advance, and for the purpose of our estimate, we will assume there will be no further advance. If we continue to import our nitrate in increasing quantities as during the last ten years, and this would be necessary to meet the growing demands of agriculture, and pay the same price we paid in 1907, we will, during the twenty years ending with 1926, send out of the country no less than $473,640,495, or enough to dig the Panama Canal and leave a good balance to our credit.

To the present we have not had the means of avoiding this outflow of money, but such is not now the case. Electrochemistry has solved the problem of fixing free nitrogen into definite stable compounds with other elements by at least three commercial methods. Nitrogen is one of the most widely diffused of the elements, constituting four-fifths by volume of the air, and experts calculate that the amount of it contained in the still air covering each nine acres of the surface of the globe, is equal to the Chili saltpeter exported from South America in the year 1907. There is more nitrogen superposed on every two square acres of United States soil than was imported into our country in the year 1907. From this ever present natural resource, we can by means of cheap power obtain our nitrogen fertilizer, cyanide for gold extraction, and would have within our country a source of fixed nitrogen for explosives—thus being freed from possible helplessness in event of war cutting off the foreign supply.

This problem is now receiving the attention of the scientific and financial world. An hydro-electric power plant of 53,000 horse-power has been successfully operating for some time on the fixation of atmospheric nitrogen in Norway, and it is now to be increased with 200,000 horse-power, and another plant of 120,000 horse-power is about to be erected in Norway, while Canada is preparing to set 60,000 electric horse-power to work on the same line. The cost of water power for these several plants is, or will be, from one-fourth to one-half what similar power would cost in the United States. An authority recently stated, after reviewing the development in Norway: "Norway saltpeter is destined to remain the only direct competitor of the Chilian variety." Shall the Americans patiently see this prediction fulfilled?

The manufacture of sodium nitrate, at a cost to compete with the Chili product, is a typical example of the conservation of our inexhaustible resources under one of the definitions as propounded at the joint conference. We have as ready access to nature's store of nitrogen as the people of Norway; millions of available water power, and an immensely greater internal market for the product.

The conservation of our exhaustible resources is perhaps of less importance than the conservation of our inexhaustible resources to the present generation, but immensely more to posterity. As an example, we will take our natural exhaustible resources—coal and oil.

Carbon is, I believe, as important to man as any other one element, entering constantly into his manufacturing and

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commercial life. Nature provided a certain amount of carbon in fixed chemical combinations, as our natural resources coal and oil, which we have been consuming and wasting in a prodigal manner. The total amount supplied by nature is limited. Our experts now know approximately the amounts we have in stock and how long they will last, for end they surely will.

These two resources are mainly being consumed in the production of what the scientific world calls "wave motions"—light or heat waves, both essential to our way of living, either for the production of light to our eyes, warmth for our bodies, or heat for our domestic, manufacturing and transportation uses. There are other and perhaps unavoidable uses of our fixed carbon, as, for instance, a reducing agent in metallurgy, the production of power for ocean-going vessels, the making of carbides, etc. For that portion of the carbon consumed in producing wave motion, and it represents a large part of the total, a ready and everlasting substitute is to be found running to waste in all sections of our great country—our natural inexhaustible resource, water power, which can be converted into electricity, an ever ready servant for the production of wave motions and mechanical power for transportation.

The most logical course to pursue in the conservation of our natural resources is evidently to begin with the forest, as is now being done by our efficient Forest Service, in order to assure the continued flow of waters; next the construction of great hydro-electric power plants, and then the creation of waterways. The electric power would furnish the power for transportation, whether by railway or water, and electric current for lighting, heating and electrochemical uses. The waterways would lend themselves to irrigation. Such a project carried to completion would usher in the electrochemical age, and would actually con-

MOUNTAIN OF NITER ON EDGE OF DEATH VALLEY, CALIFORNIA.
One of the deposits which cannot last forever.

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serve our natural resources of whatever character.

Electrochemistry is undoubtedly destined to play an important role in the conservation of our natural resources. In its more modern form, and especially as applied to metallurgy, it is still young, becoming prominent in 1888 at the time of the beginning of what is now one of our largest electrochemical industries, the manufacture of aluminum by electricity. Within the twenty years since that date, great strides have been made, a number of chemical and metallurgical processes having been converted into electrochemical and electrometallurgical ones in a very successful way, and to the advantage of the industrial world, while at least five new materials, previously unknown, are now sold in the world's markets, they having been made possible of production by electrochemistry.

BEGINNING WITH THE FORESTS.
One of the men who are pioneering in saving our resources.

Electrochemistry is in fact a creator, transforming the cheap, and perchance, useless wastes into products of value. It works either with the silent invisible electric current, or by the stress of heat. It lends itself to the ready adjustment of temperatures from that of the atmosphere to the highest attainable on earth, one in which the metals, rocks and all things earthly disappear in vapor. It tears asunder the elements as joined by nature and rearranges them under man's guidance. Thus it has made ordinary sand unite with carbon and form the well-known product — "carborundum." In another instance, it converts "culm"—the waste material of the anthracite coal mines, into valuable graphite. In another case, it has enabled us to extract from sand metallic silicon, a silver colored body, which has found a place in our arts and manufactures. As another example, it fuses in the electric furnace the soft amorphous bauxite into "alundum," suitable for use as an abrasive and refractory material. And in still another case, lime and carbon are made to unite in the electric furnace to form the valuable product — carbide of calcium, now well known as the source from which our familiar acetylene light is obtained. Electrochemists are now earnestly at work on problems of even greater magnitude than any of these, as, for instance, the electrometallurgy of iron and steel; and all this without calling upon our exhaustible natural resources, but by the utilization of the energy of a water fall.

The first hydro-electric power plant of considerable magnitude in this country was put into operation at Niagara Falls in the fall of 1895, since which date quite an electrochemical center has sprung up at that point, and there is now approximately 125,000 horse-power being utilized in the work of producing phosphorous, carbide of calcium, alundum, caustic alkali, bleaching powder, metallic sodium, aluminum, metallic silicon, carborundum, artificial graphite, chlorate of potash, and other products, the united values of their annual production amounting to many millions of dollars. These Niagara products may, to the great industrial world, seem small, but they have been developed within a few years. Were these products being made by any means other than water power, serious inroads in our natural exhaustible resource—carbon, as it appears in coal and oil, would at the present time be occurring.

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LOST ART OF TEMPERING COPPER REDISCOVERED

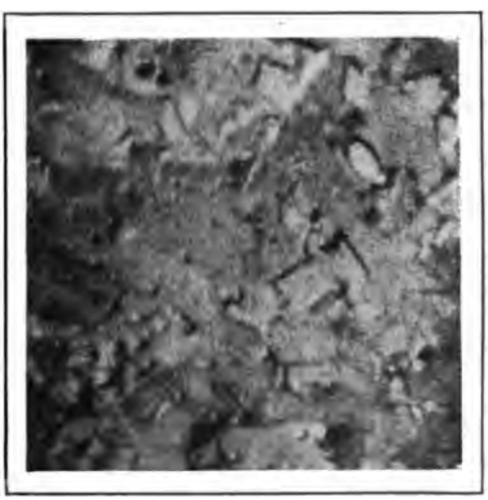
By ROLAND ASHFORD PHILLIPS

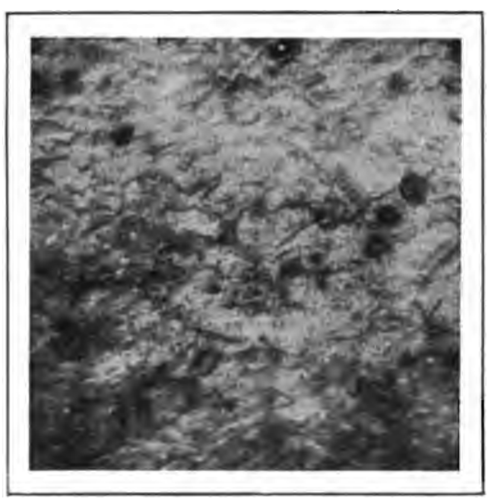
THROUGH mistaking another compound for borax, while working at his trade as a jeweler, David Lamon, of Denver, has suddenly found himself in possession of the much sought after method of hardening copper. This powder, instead of softening the metal, as borax does, instantly changed the heated copper into such a degree of firmness that manipulation was impossible. Quick to take the advantage that fortune had so unexpectedly thrust upon him, the jeweler at once made a critical analysis of the compound, determined the ingredients and finally protected his wonderful secret by a patent.

The art that was old when the pyramids were building, and which seemed to be lost with its discoverers, to remain a mystery and a hopeless secret for centuries has again been given the world by the fortunate blunder of an unsuspecting jeweler.

Heretofore the combined efforts of earnest scientists to treat and harden this metal, have either been in merely glazing the surface, or by addition of certain substances while in a molten state. Neither of these processes has really accomplished all that could be desired, nor has the treatment been put to practical use.

Contrary to these methods, the Lamon process not only hardens the copper, but tempers it as well. It is neither treated in the molten state, nor glazed, but the finished product, in any and all shapes, is given a complete and lasting physical change. The tensile strength is increased





COPPER BEFORE TEMPERING. COPPER AFTER TEMPERING.

Showing how treatment of the metal changes its appearance. This is due to a rearrangement of the atoms, which thereby greatly increases the hardness of the substance.

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and the life of the metal lengthened more than treble.

Yet invariably, a new idea, a new process, or a new discovery has been received with almost universal ridicule. Robert Fulton was probably the only man who could have aided Napoleon in crossing the English Channel, in his ambitious attempt to conquer England. Even this great leader's mind rejected the idea of boats being propelled by

DAVID LAMON, INVENTOR OF THE NEW COPPER TEMPERING PROCESS.

steam. Not so many years ago a certain unknown read a paper before an assembly of English manufacturers in which he declared he had discovered a new and a cheap way of making steel. And not a man in the entire hall was convinced. One and all declared the method to be absurd; yet the reader of that paper was Mr. Bessemer, the inventor of the Bessemer steel process, a method that instantly

MACHINE IN WHICH THE TEMPERING OF COPPER WIRE IS ACCOMPLISHED AT THE SPEED OF 200 FEET PER MINUTE.

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revolutionized the steel industry of the world.

But Mr. Lamon's persistent efforts and his tireless determination to prove to the cynical world that his discovery was practical and of the most vital interest finally convinced sufficient capital, and through this combined effort has been erected a huge plant, nearly ready for immediate operation, where pig copper will be sent in one door, and be turned out at another, in finished state, ready for the market. This finished product, to be known as Lamon copper, will be used for all commercial purposes, from wire to automobile engines.

The process is extremely simple, and any one of ordinary intelligence can readily understand it. Taking the treatment of copper wire, for instance. Between the two huge reels is located a fifty foot furnace. As the wire leaves one reel and is wound around the other, it passes through a fifty foot flame. Here it is brought to barely the melting point. Instantly it passes through another compartment, into which is fed, by means of a hopper, a fine compound. This powder, the composition of which is the vital secret, is absorbed by the heated wire, in quite the same manner as a bit of warm toast absorbs cold butter. From here the wire is carried along, cooling gradually, finally winding itself about the opposite reel, undergoing the complete physical change in perhaps less than five minutes.

The reels revolve at different speeds, according to the weight of the wire being treated. Common telephone wire, of ordinary size, is run through the furnace at the rate of about 150 feet per minute.

To further prove that his process actually effects a change in the minute cubes and crystals of the metal, a test was recently made at Cornell University. This showed, by photographs, made under a powerful magnifying glass, that a rearrangement of the atoms or molecules actually took place, and that this method, of all methods, was the supreme one.

To those who are even slightly interested, the vast possibilities in which this tempering can be used will suggest themselves. Its field is limitless. In the matter of telephone and telegraph wire alone —and this is but one item in the vast copper industry, the future seems startlingly immeasurable. Wire, exposed to all weather, extreme heat and cold, breaks continually. Wind, sleet and snow affect it in no small degree. After stringing, it proves to be in constant need of watching and repairing. Treated by this new process it will seldom if ever break and

Two Trolley Wheels of Different Sizes.
The larger was treated by the Lamon method and shows no sign of wear after traveling over 8,000 miles. The smaller wheel ran but 1,200 miles, wearing down as the photograph proves.

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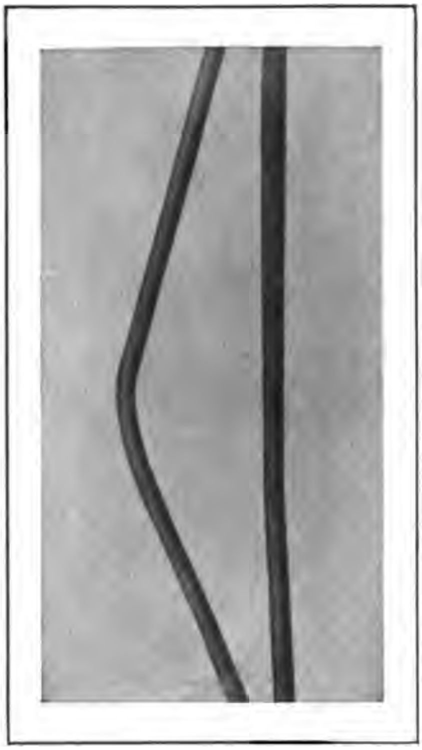
is given the strength and durability of steel. And when one considers that one of the big telephone companies alone uses over fifty-five million pounds of copper wire yearly, at a cost of not less than eleven million dollars, and realizes, as he surely must, that it is but one of the countless uses to which the wire may be put, the possibilities loom up greater than ever. A dozen plants, treating wire alone, could be put into operation at a good profit.

And what appears of far greater importance, the cost of treatment is so slight, that the tempered metal can readily be sold at the present price of the raw material. That is, today the market price of pig copper is quoted somewhere around twenty cents a pound. Put through the Lamon process, increasing its strength, its durability and its usefulness fully sixty per cent, there will be added barely two and one-half mills per pound, or about five dollars to a ton.



Two Lengths of Regular Size Trolley Wire.

The piece treated by the "Lamon" process is scarcely bent, though it has been pulled vigorously across a man's knee. The ordinary piece of wire, as the photograph shows, quickly bent.

Quite recently, as an experiment only, the dies of a certain manufacturing concern were tempered, and a letter from the president of the company stated that the life of each die was trebled, although the striking pressure of 1,200 pounds was sustained.

The small item of treating trolley wheels proved to be a decisive and interesting experiment. Accepting the statements from the railroad company's engineer, the average copper wheel will run from twelve hundred to three thousand miles. After this lapse of time it begins to blister—the blister crumbles into dust and the wheel is ruined.

The life of treated wheels, as shown by actual tests, ran from eight thousand miles up to almost double that. In this one particular, the saving gained by even a minor article is not to be laughed at. The life of a trolley wire, being subject to a continual wasting wear and tear—and especially so at the curves—will, under this treatment, be lengthened from nine months to three or more years. Taking these few facts into consideration probably three-cent fares will not be so difficult to introduce in the future.

To awaken interest and also to strengthen his proofs, the inventor of this process is giving to his friends small copper screwdrivers, treated by his method. And though barely as thick as a copper cent, with an edge almost razor-like, they will turn in the most stubborn screw without the least trouble and as easily as if made of steel.

These mentioned experiments immediately bring to mind countless other uses to which this tempering will be of lasting benefit. Besides wire there is suggested the multitude of electric appliances, copper sheeting and tubing, automobile engines, firearms and armor plate.

With the steady advance of electricity, in its various forms, copper becomes more and more of a necessity, and the application of this process, at scarcely any added cost, will give it a world demand.

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DRAWBRIDGE A MONUMENT TO HARD LUCK

By LANIER BARTLETT

FOR a railroad to be suddenly compelled by the United States government to build a $200,000 drawbridge over a 180-foot strip of dry ground is a situation which might be very properly summarized in the words "hard luck."

A railroad in California has had to face this peculiar anomaly, and its $200,000, 180-foot bascule drawbridge has just been completed over a waterless waterway. It stands as a huge monument to hard luck—that is, from the railroad point of view. The bridge is one of the longest and finest of its type ever undertaken in the West; and it certainly looks imposing, and one must add, useless, straddling the sands near Long Beach.

The story of its building is the story of a capricious river, a lost channel and an old government map which stuck stubbornly to the facts that were originally imparted to it.

In time past the San Gabriel River wandered down through a wide slough across the marsh between Long Beach and Wilmington and slipped into the oblivion of the Pacific at the spot where the anomalous drawbridge now stands. It is a typical southern California river, often bottom up for months at a time, and distinguished by its sudden fits of aberration, like all mountain-born streams of semi-arid regions.

Years ago the San Gabriel decided it would rather give itself up to some other part of the Pacific. Its old point of departure into the bosom of the ocean was twenty-three miles from Los Angeles and about three miles east of the port of San Pedro. Later it chose for its home stretch a slough several miles further down the coast, below Long Beach, expanded the slough into what is

THE HARD-LUCK DRAWBRIDGE UNDER CONSTRUCTION.

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A View Showing the Dry Land Over Which a Railroad Was Compelled by the Government to Throw a $200,000 Drawbridge.

some pretensions at its old point of debouchment, and a light railroad trestle was thrown across it, without objection from other interests. This piece of road is now a part of the San Pedro, Los Angeles and Salt Lake Railroad system.

Recently a company was formed for the development of the long slough which connects Long Beach and Wilmington, the latter being the upper portion of San Pedro harbor. The government is spending millions of dollars on the improvement of San Pedro harbor, to make it adequate to the rapidly increasing commercial importance of the great Southwest. The private corporation mentioned is dredging a deep waterway connection between Wilmington and Long Beach, whereon are to be located docks, ship building yards and other industrial plants.

now known as Alamitos Bay, and left the old mouth to gradual effacement by drifting sands and the silt of tides.

In the days when the old Los Angeles Terminal Railroad was built from Los Angeles to San Pedro the San Gabriel still maintained a channel of

"We should have a direct outlet to the

EXCAVATING QUICKSAND INSIDE OF COFFERDAM FOR THE PIERS OF A DRAWBRIDGE IN A LOST CHANNEL.

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ocean," said these men. "A channel cut right through here, with jetties thrown out to protect the entrance, would be ideal," and they put their fingers on the portion of their maps which showed the railroad trestle.

"But dry land isn't navigable," retorted a railroad representative. "You can't clip our right of way in two like that."

"Dry land is navigable if it once was and the government hasn't officially noticed the change," replied the corporation; and forthwith hunted up an original government map in the office of the United States army engineer in Los Angeles.

Sure enough, that map declared the old San Gabriel channel navigable at this point. This meant, of course, that it was still under the jurisdiction of the War Department, which, if the old map could not be disproved, would hold the right of navigation at this point inviolable, if asked to do so.

To boil a long story of a stubborn contest down to the fewest words, the government finally declared the lost channel still technically existent and navigable, and granted the corporation the privilege of dredging it out to a sufficient depth to allow the passage of sea going vessels. Then the railroad was ordered to build an adequate drawbridge across the navigable strip of apparent terra firma.

Beneath the surface the old channel was not by any means as lost as it appeared from above, and the engineer who had charge of the foundation work of the bridge found himself confronted by a most trying task. An appalling condition of quicksand soon developed, and it was only after accomplishing a difficult piece of engineering that Charles W. Corbaley, the young engineer in charge, overcame the discouraging situation.

JUST A PART OF THE HARD-LUCK BRIDGE. THE ROCKER ON WHICH THE LONG DRAW ROLLS.

The foundations of the bridge consist of three immense concrete piers resting on piles, the bottoms of the piers being forty feet below low water line. Before these could be placed it was necessary to

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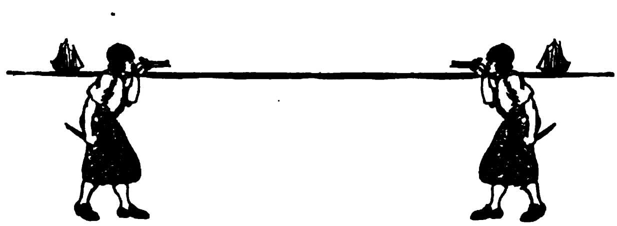
construct heavy cofferdams and excavate holes fifty by sixty feet and forty feet deep, in the quicksand, for each pier. The quicksand gave the engineer a terrible struggle and it became necessary to employ divers to plug up holes in the cofferdams under water to prevent the quicksand from refilling the excavations.

The material was excavated with a huge dredger bucket, without pumping the water from the cofferdams, and the foundation piles were driven through the water and cut off by divers. Braces for the cofferdams were also placed by divers. After the piles were cut off, four feet of rich concrete was placed in the bottom without removing the water, to prevent the quicksand from rising from the bottom and filling the holes. The reason the excavations were made and the piles driven with the cofferdams full of water was that the weight of the water balanced the raising power of the quicksand. After the concrete in the bottom of the excavations had hardened the cofferdams were pumped dry and the concrete piers installed.

The bridge is of the bascule type with a draw that is raised, not swung. Operation is by electricity. The total height from the floor of the bridge to the top of the counter-weight box is 225 feet. The bridge proper was constructed and installed entirely by a Los Angeles company, over which fact residents of Los Angeles express much satisfaction, as it is a mark of the recent industrial development of their city, which has emerged from a tourist resort into the commercial and manufacturing center of the rapidly growing Southwest.

However, the San Pedro, Los Angeles and Salt Lake Railroad probably would rather have seen the city's industrial prowess advertised in some other way than by the railroad's expenditure of $200,000 for a model drawbridge over a depression in a sand dune.



Fate

Forever, Fortune, wilt thou prove
An unrelenting foe to love,
And when we meet a mutual heart,
Come in between and bid us part?

—James Thomson.

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A RAY OF HOPE FOR THE HOPELESS

By H. G. HUNTING

THERE is hope for the hopeless. Science has touched at last, with a treatment which gives signs of help where no help was believed to be, the dread locomotor ataxia.

In the city of Chicago two physicians are now conducting a series of experiments—they themselves claim their work to be little more as yet—which have met with so great a measure of success that, in spite of their desire to keep the matter quiet till greater certainty is assured, the news of it has escaped their guard. Cases of locomotor ataxia have been very greatly benefited. The doctors do not say they have accomplished cures. They simply tell the inquirer that some of their cases look very promising and some of their patients have received great relief. And the fact that they are cautious in their claims and conservative in their statements and that they are working with and through physicians already attending cases brought to their attention is evidence at least of their desire to give to the world all that they have discovered.

To the work of Dr. F. H. Blackmarr and Dr. E. S. Bailey, is due the discovery of the beneficial effects of a combination of American minerals, newly discovered and believed to be of much greater value than any single element of the sort which has been applied to like purposes.

"Treatment with this material by the method we have devised," Dr. Blackmarr states, "seems to yield many of the good effects of radium treatment, without any of the bad results. It is far less costly and absolutely safe. If a case of locomotor ataxia has not gone too far, we feel confident of giving great help. We have relieved cases in the pain stage

PROTECTIVE DRESS DESIGNED FOR X-RAY OPERATORS.
This shows that dangers from the ray are recognized.

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of the disease very quickly. I have one case of a man who has been so much helped that he appears to be on the road to a fair degree of recovery. It is too soon to make sweeping claims. We have been very severely criticised for saying as much as we have about the matter, but we are only relating just what has occurred. We have been much misquoted, however, and so our work and its effects so far have been misunderstood. I have hopes for what we may be able to do but I do not want to raise any false hopes."

MOUTH-PAD OF THO-RAD-X PREPARED FOR PYORRHEA TREATMENT.
The pad was attached to a sheet of paper on which was pasted a cross of lead-foil. A photograph was taken by means of the rays of Tho-Rad-X contained in the pad, and the result is pictured on opposite page. The pad is lined with aluminum and attached to the paper with surgeon's adhesive plaster.

A report of some length was presented by Dr. Bailey to the Southern Homeopathic Medical Association, at a recent meeting at New Orleans, and attention was widely attracted by his statements. In his report Dr. Bailey said of the material which he uses, which he calls Tho-Rad-X: "It is made up of radioactive materials. The new substance, while far from being inexpensive, will be within the reach of everybody who needs it for treatment. Its action is quite as efficient as that of radium if given time to act. There is not enough radium in the whole world to treat all the people who need its curative properties.

"The therapeutic value of our Tho-Rad-X has been established beyond question in the fifteen months that we have been using it for the treatment of diseases. It never has failed to give relief and in many cases it has cured. Some of the diseases on which it acts beneficially are locomotor ataxia, cancer, tuberculosis of the skin, ulcers, birthmarks and nervous affections, including neuritis, from which so many people are suffering. Its rays are as effective as those of radium although it does not act as quickly. Its moderate action keeps it from being harmfully caustic, as radium is likely to be when in the hands of unskilled persons. It has the same selective power as radium —that is, it seems to act only on tissues that are diseased, having no effect on healthy tissues."

One Chicago patient has been treated for X-ray dermatitis, received ten years ago, involving an area about ten inches in diameter. The skin and muscles had fallen away, leaving in the center a small malignant growth. He has entirely recovered from the dermatitis and the growth is almost eradicated.

Dr. H. J. Drake, of Iowa, is now under treatment. He was seen and makes the following statement to the writer: "I had a pretty bad case of X-ray dermatitis involving back of fingers, hand and wrist. I lost the nails of my fingers three times during nine years and had a malignant ulcer of one finger. I began treatment March 26th, 1909, and April 9th, 1909, the ulcer was practically healed. I have no pain now, and there is a marked change of the dermatitis for the better."

Another Chicago patient suffered with optic paralysis, and after three weeks of treatment is able to go about without attendance. A second patient, completely blind from this same affliction for six months, recognizes daylight now after two weeks' treatment.

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These benefits have all been accomplished by varied applications of the Tho-Rad-X.

Dr. Blackmarr states that he has made no official reports to the medical societies of many of the cases in which success seems to be following his efforts, because the experimental stage has not been passed. As to the kind of cases of ataxia which he thinks may be benefited, he says:

"Some patients are in such condition that they cannot respond to treatment. You know there are persons who have constitutions predisposed to disease. The greatest blessing a man can have is to have been well born. Some people have not, and never have had, recuperative energy. Such ones we cannot hope to help, when they have fallen victims to such a disease as locomotor ataxia. They have nothing to build upon. Neither can we help a man if the disease has gone so far that the spinal cord has materially changed in structure. But where there is life there is hope. I will say that not one case of locomotor ataxia has come to us which we have not helped."

PHOTOGRAPH TAKEN WITH RAYS FROM THO-RAD-X MOUTH-PAD PICTURED ON OPPOSITE PAGE.
Dark cross in center is the lead-foil seen in other photograph. Note that the aluminum inner lining and the surgeon's plaster, where attached at sides, as well as the lead-foil cross, appear, proving that rays from the Tho-Rad-X radiate in all directions.

CAST OF TEETH UPON WHICH THO-RAD-X PAD WAS MOULDED TO TREAT FOR PYORRHEA.

Cases are being treated with Tho-Rad-X in many localities by the physicians in charge. The methods are simple, consisting in covering the affected parts with a pad, film or semi-solid in which the Tho-Rad-X is incorporated. No harm results from its constant application. The cost of Tho-Rad-X varies according to the amount of material necessary for the case. Treatment for ataxia may be as low as forty dollars, where the pad needed is not large, or may run as high as one hundred dollars or even more, when more of the composition is used. This, however, is hardly prohibitive for the man who has suffered the early pains of ataxia and who has to face the gradual loss of his natural powers in a crippled future.

The photographs reproduced herewith illustrate the power of the rays from the material Dr. Blackmarr is using. Description of the method of taking is given in the caption in each case. It is not practical to photograph cases under treatment, for obvious reasons, but work is being done each day upon cases which are progressing toward remarkable cures.

Dr. Blackmarr's own somewhat technical and very conservative statement regarding the new substance, written specially for the TECHNICAL WORLD MAGAZINE, follows:

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"The excuse for the existence of Tho-Rad-X and the spending of over two years of experimental and clinical work with materials known to be radioactive, was to be able to supply a substitute for radium. The quantity of radium in the world that can be utilized for the treatment of disease is infinitesimal and exceedingly costly. Its wonderful selective influence in therapeutics; the treatment of cancer, lupus, ulcerations, birth-marks, neuralgia, neuritis, and kindred diseases has been positively demonstrated, and, in consequence, the need of the possession of radium is universal.

SHEET PREPARED TO TEST THE RAYS OF THO-RAD-X.
Letters were cut from lead-foil, pasted on paper, and the board at the left was placed over them. The board is three eighths of an inch thick. The whole was then placed within two paper envelopes and a photo taken with a pad of Tho-Rad-X. The result appears opposite. The disks at the left are brass slugs. The board did not cover them.

"Court records are evidence that many electro-therapeutists have been unfortunate in the use of the X-rays. Clinical records are evidence that radium treatment must be prosecuted with exceeding care. During the last twelve years that I have been engaged in the treatment of cancer, lupus, etc., by X-rays, Finsen light, and other adjuvants, I have felt, as other operatives have felt, the need of something that could be used in conjunction with the X-ray, to moderate its effect, and in photo-therapy to intensify its effect. It is enough to say that this substance under discussion will cure the worst forms of X-ray burns. On the other hand, in photo-therapy it has been demonstrated that the filtered light rays from arc and incandescent sources act superficially and occupy a long period of time in accomplishing but little. This substance alone, over the same area, will accomplish the same results as in phototherapy, in a much shorter period of time.

"The application of Tho-Rad-X is

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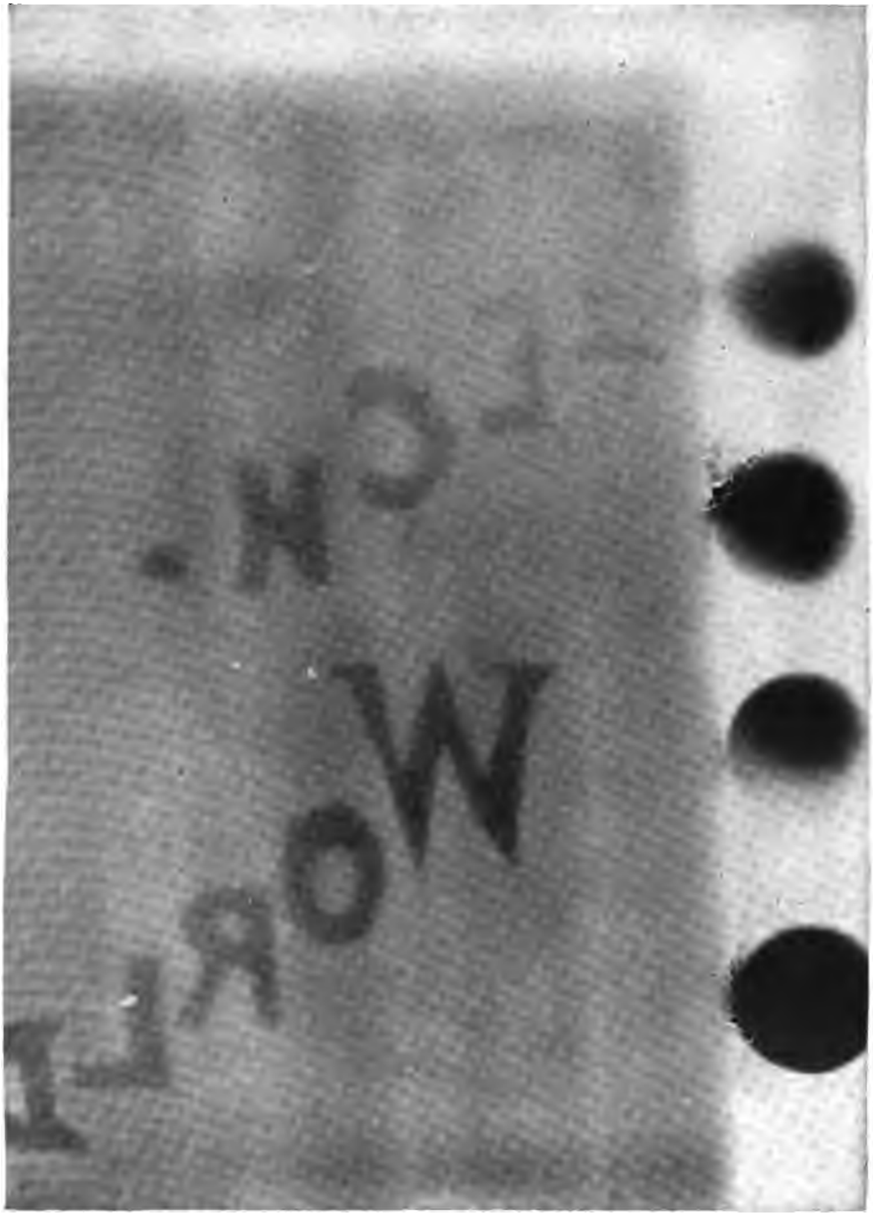

PHOTOGRAPH TAKEN THROUGH A BOARD WITH THO-RAD-X.
Letters in lead-foil show less plainly in upper right hand corner because of the larger amount of paste used to make them stick. The same cause gives the uneven result from the brass slugs at the right. See original opposite.

found absolutely safe. It can be used at all times upon any area or in any cavity of the body, when incorporated in the proper containers, as a fabric, as a film, as a powder when incorporated in aluminum or other containers, for application in cavities of the body. Used in conjunction with X-rays, over-treatment by the X-ray will be unnecessary. The moderate, mild X-ray influences are retained and continued by the constant application of Tho-Rad-X, with the constant influence in favor of the relief or cure of any degree of dermatitis created

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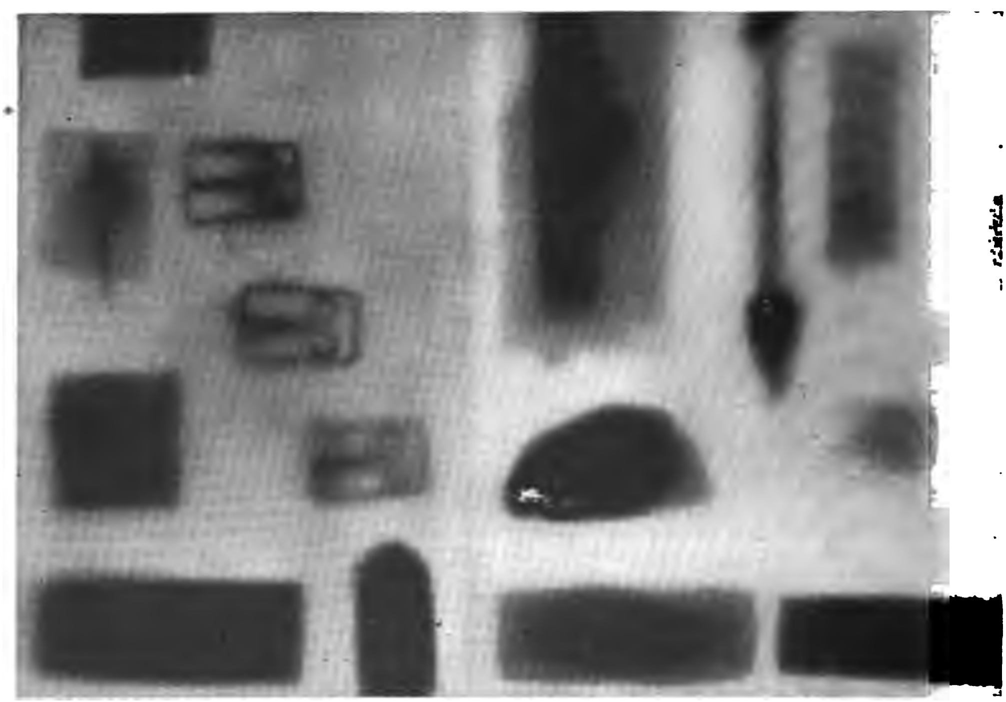
ORIGINAL PREPARED FOR THO-RAD-X PHOTOGRAPH BELOW.

From left to right, beginning at the top, the articles are as follows: Surgeon's plaster, leather, glass tube, paper of needles, steel clips, lead-foil (above), tin-foil and pin (beneath); second row—asbestos, soap, steel clip, wood; third row—brass, aluminum, tin, copper. See below, Tho-Rad-X photograph, taken through double envelope.



THO-RAD-X PHOTOGRAPH TAKEN OF THE MATERIALS PICTURED ABOVE.

The whole group is reversed because it was turned face toward the plate.

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by the X-ray. In conjunction with photo-therapy, its application demonstrates a beneficial effect upon the deeper structures.

"Tho-Rad-X used alone acts much slower than X-rays and radium, but in this action alone we have a considerable degree of protection against terrific caustic or chemical changes.

"It is unnecessary at this time to give a resume of what radium will accomplish. Magazines and newspaper reports have given this clinical evidence. The use of Tho-Rad-X demonstrates much of the physical phenomena associated with radium.

"It is my earnest belief, and the result of my clinical experience, that it *does* accomplish what radium accomplishes, and more. By more, I mean this: Cases that we have treated have demonstrated an influence emanating from this material which cannot be reasoned out—something not tangible, something that cannot be seen.

"Ten years ago I published a theory accounting for the effect of the X-ray upon pathological conditions; namely, that X-ray produced a leucocytosis, undoubtedly having its action upon the red bone marrow, the source of certain leucocytes which assist in giving us immunity from disease. The criticism was that all these diseases had pronounced leucocytosis to begin with—Nature's effort to overcome the disease. The answer was, in a stimulating and tonic effect of the ray producing leucocytes with greater resisting power. This theory I still believe. In very few of my cases which I have cured by the X-ray have I used the caustic action of the X-ray.

"Now, to account for the beneficial effect of the moderate influence by Tho-Rad-X. We know that there is an elimination of gas evolved from some radio-active substances. Is it so difficult to believe that a gas or emanation emitted from these radio-active elements may be absorbed and taken up by the blood and accomplish in the same way the vitalization of the scavenger leucocytes in the blood?

THO-RAD-X PHOTOGRAPH OF A TUBE OF RADIUM.
The pad used was just the shape of the light patch, and the tube of radium lay beneath it. The dark spot on the lighter ground is the heavier portion of the tube containing the radium. The smaller portions of the tube are lost in the reproduction though showing faintly in the original.

"I know that this bit of theory will cause many to smile, but it is possible to demonstrate that epithelioma and lupus will yield to the moderate, non-caustic effect of the X-ray, and will also yield to the influence of Tho-Rad-X. I make this statement because some operators believe that it is absolutely necessary to destroy tissue before it can be cured. It

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is wrong, however, suddenly to unload upon the system products of disintegration, as it is difficult for the mechanism of the system to take care of it. It is self-evident that this wonderful mechanism would be better able gradually to eliminate a small excess of waste products, than to overwork the slave in surcharging the system by an avalanche of products of disintegration.

"So much for theory. We know that the material which we have named Tho-Rad-X is having very beneficial effects upon cases of locomotor ataxia, cases of cancer of several different varieties, severe nervous affections, bad cases of X-ray burns, and pyorrhea alveolaris. Our hopes for and belief in its future and in the good that will be done by it, are very great."

BUILDING THE WORLD'S MOST BEAUTIFUL ROAD

By DR. ALFRED GRADENWITZ

Berlin Correspondent Technical World Magazine.

THOUGH the youngest of the great European capitals, Berlin, during the last few decades, has undergone a development unequaled in intensity on the old continent, and is rapidly becoming one of the largest and finest cities in the world. While New York, owing to its situation on an island, required, for being allowed to grow beyond the natural boundaries of Manhattan, the construction of a number of huge bridges and the institution of an enormous river traffic for the conveyance of both passengers and goods, Berlin was more fortunate in having unlimited tracts of low country round it, which hampered, in no way, its continuous expansion.

THE REICHSKANZLER-PLATZ, SHOWING SUBWAY ENTRANCE AT BOOTH TO RIGHT.
Part of the world's most beautiful boulevard.

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PRACTICALLY THE BEGINNING OF THE BOULEVARD.

The Zoological Gardens, situated on the outskirts of the Berlin of old, which until about ten years ago, seemed to constitute the extreme limit to its possibilities of development, are now surrounded by an enormous area covered with a dense network of streets, and the famous Tiergarten Park, which until quite recently lay outside the city, is now located in the center of what is fitly called Greater Berlin, being encircled by a number of thriving sister communities of the metropolis.

It is a well-known fact that the Kaiser's ambition aims at nothing less than making Berlin the most beautiful city in the world, and to him is due the suggestion and promotion of many plans which actually tend in this direction. Though the Siegesalle or Avenue of Victory, constructed on his personal initiative, with its one hundred white marble statues, traversing the Tiergarten, possibly is not one of the most tastefully arranged avenues—as acknowledged by the witty criticisms of the Berliners themselves—it may claim the merit of being unique of its kind. A far more grandiose project, which is estimated to involve an outlay of about twelve and one-half millions of dollars, has likewise been started on the suggestion and under the personal supervision of the Emperor, whom it offers a welcome opportunity of indulging in his predilection for things military, viz., the construction of a magnificent boulevard leading from the very heart of Berlin through the Tiergarten and the beautiful forest of Grunewald, to the military practice grounds at Doeberitz. Besides being the longest and most beautiful boulevard in the world, it is to form a gorgeous avenue of march for the soldiers of the Imperial army, enabling them to travel in a straight line between the castle and the practice ground.

This project has long been a favorite scheme with the Kaiser, who is said to be personally responsible for many cor-

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Building the Sand Dam Across the Stoessensee.
The trestle bears trains transporting sand.

The Doeberitzer Heerstrasse — or military road — as this boulevard is called, is about eighteen miles in length and is likely to excel in many respects, even the Champs Elysées, that great work of the Emperor Napoleon. Its first portion, beginning from the Imperial Castle, traverses a number of existing streets and roads, running along the famous Unter den Linden Avenue, and across Brandenburg Gate and the Avenue of Victory, and continuing along the Charlottenburg Road — through the Tiergarten and the Charlottenburg Gate—and thence over Bismarckstrasse, the Kaiser-Damm and the Forest of Grunewald, in order finally to reach in a straight line traversing hills, rivers and swamps, its goal, the military camp at Doeberitz.

While the avenues traversed by the

rections of plans and details of construction. The general public, however, openly or secretly, criticises that great work, both because of its expensiveness and its mainly military usefulness. Contributing to so large an extent to aggravating the burden of taxes intended to fill the military coffers, this scheme cannot possibly be looked upon by everybody with unmixed enthusiasm.

As it is, this project deserves a more than passing interest, both because of its originality and the important part it is bound to play in the beautifying of Greater Berlin. Having been commenced some years ago, the work is now sufficiently advanced to allow of its grandeur being appreciated, and a short description of this marvelous work of engineering skill will, doubtless, be found interesting to the reader.

The Method of Setting Trees and Flowers Along the Boulevard.

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first portion of the road did not require to be rebuilt, a thorough reconstruction had to be carried out on the Bismarckstrasse, which, until about six years ago, had been rather a modest street lined with the usual Berlin tenement houses, interrupted only by a few villas that had been preserved from the early times of Charlottenburg—when this still was an independent country town. This humble street, about seventy-five feet in width, was quite unexpectedly destined to something great by the very will of the Emperor; it was a peculiar sight to watch all the houses on one side of the street being pulled down or sawed off at a surprising rate in order to make of this street a pompous avenue 165 to 170 feet in width with broad sidewalks, three roads, electric lighting, electric tramways and subway, flower beds and other features.

The inauguration of the subway line traversing Bismarckstrasse may be said to mark an epoch in the annals of the capital, this being the first instance of the most frequented streets of the city being connected directly with the still crude extreme west of Berlin-Charlottenburg. Those who had been prompted by curiosity to undertake the short underground trip to the Reichskanzlerplatz — Chancellor Square — which had so far been quite an unknown place to Berliners, would be surprised to arrive at a station situated in the center of a vast square devoid of any houses so far as the eye could scan, but which formed the starting point of a regular system of wide and comfortable streets, completed in every detail to more than a mile's distance, but for the absence of any dwellings. It is true that this rapid communication between the center of the city and those splendid streets and squares had been established, not because of its present necessity for Berliners, but with a view to its future usefulness. So far

THE SIEGESALLE—"AVENUE OF VICTORY"—AN AVENUE LINED WITH ONE HUNDRED MARBLES, REPRESENTING THE KAISER'S ANCESTORS.
The boulevard crosses this after entering the Tiergarten.

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THE FLOWER BEDS ADD, IN NO SMALL MEASURE, TO THE BOULEVARD'S BEAUTY.

from allowing the city to develop in a haphazard way, on the more or less irregular streets resulting from a gradual growth, the future development was confined to predetermined channels, thus ensuring to any quarters destined to spring up in course of time a perfect regularity and all desirable uniformity. This practice, according to which the very means of conveyance are created before there is any traffic, is quite exceptional on the old continent, but will doubtless soon be imitated by other cities.

While varying to some extent according to local conditions—in the passage of bridges, gates, squares, flower beds, etc.—the width of the boulevard generally is two hundred feet. In the center there is an asphalted road sixty feet in width for light traffic, and on the left side of this, a grass plot thirty feet wide, which is at present arranged with flower beds, but will probably be utilized later for a double track of street car lines. The corresponding space on the other side of the road is arranged as a riding road. On both sides of these sections there are drives twenty-five feet wide for heavy traffic. The roadways of the latter are of well tamped broken stone construction, and have been built firmly according to the best practice with concrete sewer pipes and drains. Below the central asphalted drive, a layer of concrete was placed on a one-foot base of small broken stone above which lies an eight-inch layer of large stones. The earth on which the boulevard was constructed is a sandy soil with a foundation of clay, nearly throughout its length. The riding road, obviously, had to be given a somewhat different structure. Parallel to it and at a distance of two feet below its surface, are located two four-inch tile drains, above which comes a six-inch layer of broken bricks, while the surface is composed of sand and soil in equal proportions.

The side walks are of varying structure, their central portion being usually composed of five-foot smooth flags four feet in length and four inches in thickness, to the right and left of which are placed firmly tamped, broken stones. These, near the outside edges, are lined with a substantial coating of tar eight

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inches in width which is of a specially pleasing appearance when viewed from a carriage.

The Doeberitz military road will be lighted with electric arc lamps throughout its length, and particularly at night, will present a magnificent view. Two of its most interesting parts are the Charlottenburg Gate and the Kaiser Damm. The former is a huge and massive stone structure erected over a bridge crossing a small stream at the boundary between Berlin and the suburb of Charlottenburg. This gate will cost, when complete, $250,000, and will doubtless excel in beauty and magnificence the famous Brandenburg Gate traversed by the first section of the avenue; its towers will be lighted by electricity. Another point of interest is an extensive steel bridge carrying the boulevard over a number of railway tracks; suspended from the floor of this bridge is the steel shell of the subway which, in itself, constitutes a masterpiece of engineering. A certain portion of the subway tunnel had to be laid out in a peat moor about seven feet in depth, the substantial sandy soil susceptible of supporting the tunnel being situated at a considerable depth below the level of the subway. Intermediary between the sandy soil and the peat layer was a stratum of infusorial earth, and in order to transmit the burden of the tunnel to the resisting sandy soil throughout the length of the moor, a piling consisting of tapering trees up to twenty-five feet in length, was driven into the soil and an enormous concrete plate about five feet in thickness was placed above the head of the piles.

THE FAMOUS BRANDENBURG GATE.

The great sand dam which has been built across the Stoessensee Lake is another point of special interest. Though a bridge would have been preferable, because of its more pleasing appearance, a dam was constructed on account of the very poor foundation afforded by the mud soil. The Doeberitz Road leads through some of the finest scenes around Berlin, which have long been haunts for its pleasure-seeking inhabitants.

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THE QUEENSBORO BRIDGE, RECENTLY COMPLETED, WHICH SPANS THE EAST RIVER.
The safety of this $17,000,000 structure has been questioned by engineers.

NEW YORK'S NEWEST BRIDGE

By C. F. CARTER

NEW YORK'S great cantilever bridge across the East River, which was opened in April, having been declared by distinguished engineers to be no safer than it should be, has become the most fascinating spot in the metropolis. On every fair Sunday a hundred thousand people promenade it from end to end, some even stopping to teeter up and down like boys on a rotten plank, to see if the thing really will break down under their weight. As the bridge continues to stand up under this treatment any New Yorker who is so disposed may boast of a structure which is, in many particulars, and in all probability will ever continue to be, unique.

To begin with, it is unlikely that any other community will ever pay seventeen million dollars for a bridge of the size and capacity of the Queensboro bridge. If anything of the kind should happen it is at least improbable that the taxpayers who foot the bill will be satisfied with a bridge so badly designed that two eminent engineers, after painstaking independent investigations, will agree that even by stretching the limit of safety to the uttermost, it cannot carry more than a third of the traffic for which it was intended.

American engineers have achieved an unenviable record for building bridges

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that will not stand. There was the Ashtabula bridge which gave way under the weight of a passenger train, sending nearly a hundred victims to death in a ravine seventy-five feet below. A bridge across the Ohio fell during construction, killing eleven men. This was followed by the collapse, also during construction, of the Cornwall bridge across the St. Lawrence in which seven were killed. The climax came in the collapse of the half finished Quebec bridge across the St. Lawrence in August, 1907, in which seventy-nine men lost their lives.

This last disaster caused so much uneasiness about the Queensboro bridge, which was of the same type as the ill-fated Quebec structure, that the city government was forced by public opinion to have an investigation made. Boller and Hodge, consulting engineers, and Prof. Wm. H. Burr, of Columbia University, were engaged in June, 1908, to make simultaneous but entirely independent examinations. Five months later the reports of both experts were made public. Both reached conclusions which were not flattering to the designers nor comforting to the public.

Ordinary structural steel was found to be subjected to stresses of 24,000 pounds per square inch which, engineers agree, is beyond the limit of safety. As if this was not bad enough, some bottom chord members were found that had to stand stresses of 30,000 pounds to the square inch, or 25 per cent beyond a limit already dangerous. Nickel steel eyebars were found carrying loads of 49,000 pounds to the square inch, although the elastic limit of that kind of metal is only 48,000 pounds per square inch. Professor Burr found in his investigation, various members of the bridge were carrying all the way from ten per cent to thirty-three per cent overload.

Boller and Hodge made a stress sheet for the loads called for in the specifications; but finding that the bridge simply could not carry such loads laid it aside and undertook "to find the maximum safe carrying capacity of the structure." They concluded that by taking off a thousand pounds of dead weight per lineal foot of the bridge the city might risk opening it to pedestrians, highway and trolley traffic, provided the cars were spaced at least a car length apart.

A PIER AND TOWER OF THE QUEENSBORO BRIDGE.

Professor Burr advised that still more dead weight be removed and that the trolley cars be spaced still further apart. If that was done he thought two of the four elevated railroad tracks might be used provided the trains were spaced at least a thousand feet apart. Boller and

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Hodge were opposed to the use of the elevated tracks at all.

This last restriction in particular seems supererogatory; for there are no elevated railroad connections with the bridge and no prospect that there ever will be any. Neither are there any trolley connections nor any present likelihood thereof. Although ten long years have elapsed since the Board of Public Improvements approved the plans for the bridge it has not yet occurred to the constituted authorities that any one will ever want to cross it. The bridge, starting from an inconvenient part of Manhattan Island and leading across the East River to no place in particular on Long Island, is so far hopelessly inaccessible for passenger traffic and out of the way for trucks. In good truth the Queensboro bridge today is about as useful as a fifth wheel on a wagon is popularly supposed to be. Vehicular traffic across it at the present time is less than a third of that on the Williamsburg bridge and barely a third of that which crowds the narrow roadways of the Brooklyn bridge.

Still, these are by no means the sole distinguishing features of the new Queensboro bridge. Despite its present lack of utility, and notwithstanding the uncharitable things said about it by the consulting engineers who put it through the third degree, the Queensboro bridge, at least so long as it stands, must command recognition as a remarkable engineering achievement.

There are only four bridges in existence, one of the cantilever type and three of the suspension type, of longer span than the span of the Queensboro bridge between Manhattan Island and Blackwell's Island across the west channel of the East River. The cantilever bridge is that across the Firth of Forth at Queensferry, Scotland, which was completed in 1889 and which has two chief spans 1,710 feet long. The three suspension bridges are all in sight of the Queensboro structure, for they all span the East River, connecting Manhattan and Brooklyn boroughs of Greater New York. The old Brooklyn bridge has a span of 1,595.5 feet; the newer Williamsburg bridge has a span of 1,600 feet, while the Manhattan bridge, which, thanks to the breaking of world's records in construction, is now approaching completion, has a span of 1,470 feet. The main span of the Queensboro bridge is 1,182 feet long.

Whatever it may lack in length of main span the Queensboro bridge more than makes up in ugliness. After feasting one's eyes on the exquisite lines of the old Brooklyn bridge and admiring the more or less graceful new suspension bridges the angular, knobby outlines of the great cantilever bridge rather sets one's teeth on edge. However, there is at least the consolation that it is not quite so homely as the Firth of Forth bridge.

While both are cantilever bridges the details of construction differ considerably and the newer structure is of so much greater carrying capacity, or at least was intended to be, that the new might fairly dispute with the older the right to be called the greatest of its type in the world. Perhaps the best way to give an idea of the relative size and importance of the Queensboro bridge would be to compare its principal dimensions with those of the Scotch bridge. The Manhattan approach, then, is 1,052 feet long; the main bridge, consisting of the Manhattan anchor arm, 469.5 feet, the west cantilever span of 1,182 feet, the Blackwell's Island span of 630 feet; the Queens anchor arm of 459 feet and the Queensboro approach of 2,672.5 feet make a grand total of 7,449 feet. The Firth of Forth bridge has two spans of 1,710 feet, two others of 680 feet, fifteen of 168 feet each and seven small arches, making a total of 8,296 feet or a little more than a mile and a half, of which one mile is covered by cantilever construction.

But when it comes to breadth, height and quantity of material used in construction and intended capacity the odds are decidedly with the shorter New York structure. Only 120,000 cubic yards of masonry were built for piers for the Scotch bridge as compared with 149,700 cubic yards for the Queensboro bridge. The latter contains 74,500 tons of steel and iron, of which 5,900 tons are nickel steel, while in the Scotch bridge there are but 44,500 tons.

The clear height of the Queensboro

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bridge above mean high water is 135 feet, while the footwalks are 165 feet and the tops of the flag poles on the towers 406 feet above high water. The bridge has two decks 89½ feet wide measuring from outside to outside as compared with 118 feet the width of the Williamsburg bridge. On the lower deck there is a fifty-three foot roadway in the center with a maximum grade of cars which is constantly going on at the Brooklyn bridge terminal. The four trolley tracks, if they were in use, would be capable of handling 60,000 passengers per hour in one direction.

The upper deck is devoted to vacant space on which four elevated railroad tracks, also capable of accommodating 60,000 passengers per hour in one direction, could be laid if the bridge would

PART OF THE CROWD OF 100,000 PEOPLE WHO PROMENADE ON SUNDAY ACROSS THE QUEENSBORO BRIDGE.
The reputed danger of this crossing draws thousands.

3.5 per cent on the Manhattan approach and 3.41 per cent on the main bridge. On either side of the roadway are two trolley tracks. The outer track is for Manhattan lines, the inner for Long Island roads. The latter run under the street level at the west end of the Manhattan approach, terminating in a series of five loops, each reached from the street level by a separate stairway so that there need be none of the frantic, death-defying scrambling in front of moving bear their weight and anybody thought it worth while. On either side the vacancy is bounded by a footpath sixteen feet wide.

Perhaps the dimensions of some of the principal parts will also help to give an idea of the magnitude of the bridge. For instance there are "shoes" on top of each of the tower posts, the largest of which are of nickel steel 9 by 12 by 15 feet and weigh 140,000 pounds. Each shoe has four separate pins for the top

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chord and the diagonals. The largest tower post is 5 by 11 by 19½ feet, has an area of cross section of 1,396 square inches and weighs 126,000 pounds, which is equal to 6,460 pounds per lineal foot.

The largest diagonal is 3½ by 5 feet and 105 feet long and weighs 180,000 pounds. The largest bottom chords are 4 feet wide, 6 feet deep and 59 feet long, and weigh 240,000 pounds, which is equal to 4,100 pounds per lineal foot. These bottom chords are composed of four ribs with a maximum thickness of metal of 5¾ inches.

RAPID TRANSIT TRACKS OVER THE QUEENSBORO BRIDGE.

The largest top chord, 48 feet long, is composed of twenty nickel steel eyebars 2⅛ by 16 inches, which gives an area of 680 inches in cross section. The steel pedestals under each tower post are composed of three courses of steel castings, the heaviest of which weighs 41 tons. The total weight of each pedestal is 140 tons. The structure is held together with nickel steel pins, the largest of which is 10 feet long, 16 inches in diameter and weighs 7,000 pounds. In fact some of the members of the Queensboro bridge are as large as any in the ill-fated Quebec structure, the main span of which was to be fifty per cent longer; for the shorter bridge was designed to carry as heavy a load as the other.

The superstructure of the Blackwell's Island span and the anchor arm spans of the main bridge was erected on steel false work. The cantilever spans over the east and west channels of the river were erected with the aid of a "Z" shaped traveler. Some of the single pieces of steel were so large, the biggest weighing about sixty tons, that specially designed hoists, derricks, travelers and machinery had to be provided. A power plant of five hundred horsepower was operated on Blackwell's Island.

The titanic task of placing the enormous mass of steel in position in midair was begun in August, 1905. From this time until June 15, 1908, when the superstructure was finished, from five hundred to eleven hundred men were employed on the work with the exception of six months during which there was a strike of the steel workers. The greatest amount of steel erected in one day of eight hours was 512 tons.

Nineteen lives were lost during the progress of the work, the majority through the carelessness of the victims themselves. It would seem as if men working in places where the slightest

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misstep meant certain death would always move with extreme care; but perhaps if they did the bridge could never have been completed. One poor fellow was on the bridge giving orders to land a load of stringers dangling from the arm of a traveler. He was standing astride a rope which tripped him up and he plunged to his death on the rocks one hundred and twenty feet below.

In two instances men at work over the river disappeared and were never seen again. Both slipped and fell into the water without a human eye seeing them and without a sound to attract attention. One man had his life crushed out between two ponderous pieces of steel which were being fitted together.

There were some thrilling escapes from death, too. Steel inspector George C. Abernathy while prowling around over the bridge as his duty required, slipped and fell. Now a body falling freely from rest will, in the first second, fall a distance of 16.1 feet. Men rarely, if ever, cry out in falling. It all happens so quickly there is no time to get the muscles in motion; and besides, the swiftness of the fall probably takes their breath away. But the mind is not so hampered in its movements as the muscles. Abernathy had time to regret that he had on a new pair of trousers that would probably be ruined by a fall of one hundred and twenty feet on to the rocks. Also he worried for fear he might not be able to get around in time for the lunch for which he had worked up a very agreeable appetite until he stopped thinking very suddenly.

He wasn't exactly knocked senseless; but he was so dazed he could neither think nor move for a moment. The first thing he realized clearly was that some men were lowering him to the ground. Not until he was safe on the ground did he grasp the fact that his fall had been interrupted twenty feet from the starting point by a wing plate five by eight feet in area. Fortunately he struck fairly in the middle and did not roll, for otherwise he must have gone on to certain death.

Henry Smith, a steel worker, had an even more remarkable escape, for he took the plunge from the bridge floor level to the river 135 feet below, which had proved fatal for every other man who had made it. He retained sufficient command of his senses and his muscles to swim ashore where he found that the only outward mark of his remarkable experience was a slight cut on the head. He was back at work in four days.

Two men were on top of a tower post 320 feet above the water trying to guide a steel plate weighing several tons into position as it was being lowered by a derrick. The plate slipped into place so suddenly that it sheared off the fingers on both hands of both men as neatly as if it had been done with a pair of scissors. The unfortunates were lowered to the ground.

"Well, Jim," said an acquaintance, pausing a moment in his work and addressing one of the sufferers, "what are you going to do for a living now?"

Jim held up his stumps with a sickly grin as he retorted:

"I dunno; looks as if I'd have to be a short hand man."

And thus these men accept fate.

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WHO OWNS THE EARTH ?

VI. THE OIL INDUSTRY

By Henry M. Hyde

MADE education universal and the average intelligence of the people higher than in any other country.

Put into the pockets of half a dozen men profits amounting to one billion dollars within twenty-seven years.

Forced the creation of the first trust and wrought a complete revolution in the organization of business.

Developed tank cars, tank steamers, pipe lines, and many other startling innovations in the transportation and handling of raw and manufactured products.

These are some of the more important achievements of the great American oil industry at the end of the first fifty years of its existence.

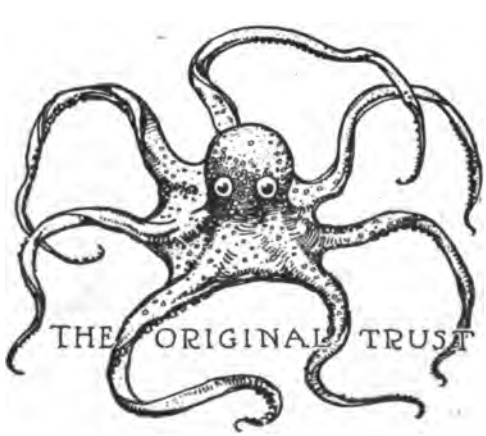
It is the most picturesque, the most spectacular, the most revolutionary business in which men were ever engaged.

Fifty years ago mineral oil skimmed from the surface of springs in Pennsylvania, was bottled and sold under glaring labels as a patent medicine cure-all. To-day the same natural product is pumped back and forth across the continent in 83,000 miles of privately owned pipe lines and is sent to the far corners of the seven seas in a privately owned fleet of more than five hundred steam and sailing vessels.

The richest man in the world owes his wealth to oil. The poorest boy in the most remote corner of the country studying at night after his work was done, by the light of an oil lamp, owes his debt also to the same product of nature. Oil founded the University of Chicago, lubricated the slides for the descent of many aspiring statesmen into Avernus and made 26 Broadway the most conspicuous and important location in the commercial world.

The Standard Oil Company, which has been the one great beneficiary of the oil business, has never been the pioneer in any development of the trade which it controls. The first oil wells were bored by other people; the first refinery built; the first pipe line constructed, and the first American oil exported by individuals and firms, who had no connection with the Standard. That organization of astute, crafty and able men has been content to wait until others have done the costly experimental work and has then speedily and completely assimilated the result of their labors.

John D. Rockefeller knew of what he spoke when he declared that the oil business was the most speculative pursuit in the world. During the fifty years which have elapsed since the first hole was bored in 1859, no less than 250,000 wells have been sunk in search of the thick odoriferous liquid which nature has deposited with



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such a lavish and uncertain hand. The total estimated cost to the men who financed the boring of these wells—every one as speculative as the spinning of a wheel of fortune—is $250,000,000. Of this vast sum not less than $100,000,000 was an absolute loss. That is, the holes for the boring of which it paid the cost, turned out to be dry wells from which nothing more valuable than scanty supplies of water could be pumped. Oil is often found where it is least expected. And the gold prospector, who wanders over mountains and deserts, with his belt pulled tight over his lean belly, is no more of a reckless and chance-driven gambler than the wild-cat oil weller, who takes the whole continent for his field and who bores a test hole today in the far Northwest and tomorrow in some little known southern country. There has been no reason why the Standard Oil Company should not be willing to allow others to do this experimental work, because, up to the present time, the problem has been rather to take care of the ever increasing supplies of crude oil, rather than to find new deposits to supply the demand. The opening of every new oil field is in fact always the scene of incredible and criminal waste. Regardless of storage capacity, regardless of any ready means of transportation, the first successful well in every new field is always followed by a tidal wave of oil men. As rapidly as their great steel drills can be driven into the earth they bore hole after hole, using pumps to get the greatest possible supply of crude oil from the earth in the shortest possible time. A gold mine camp at the height of its greatest boom is a quiet place and its residents sedate and sober business men, by the side of a new oil town after a half dozen "gushers" have come in.

Universal Intelligence

And to the Standard Oil Company must be given credit for the saving from total loss, many million barrels of crude oil sucked from the earth by greedy speculators in quantities so great that it takes years to use the production of a single season. Time after time the Standard has worked great crews of men day and night, in the building of huge steel oil tanks for the storing of unexpected oil. Two years ago it had stored in tanks in the Kansas field alone, more than 21,000,000 barrels. Every time a new pool is tapped, the Standard is instantly on the spot spinning its pipe lines, raising its great storage tanks and making ready to handle whatever quantity of the crude product the riven earth can be forced into giving up.

In 1905 the Standard Oil Company itself, produced less than twelve per cent of the crude oil in the United States. At the same time it absolutely controlled the business. Its agents set the prices for crude oil in the various fields.

Through its own ownership and control of pipe lines—a single trunk line stretching unbroken from Kansas to the Atlantic coast—it was able at will, to make it entirely unprofitable for any

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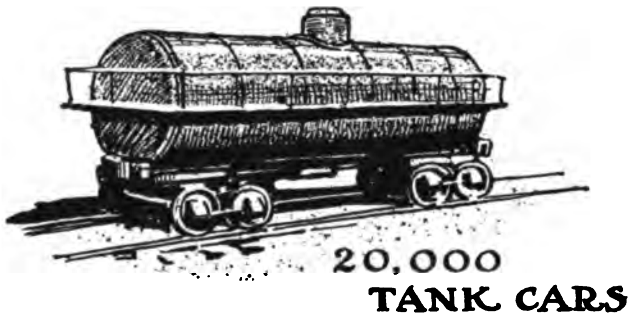
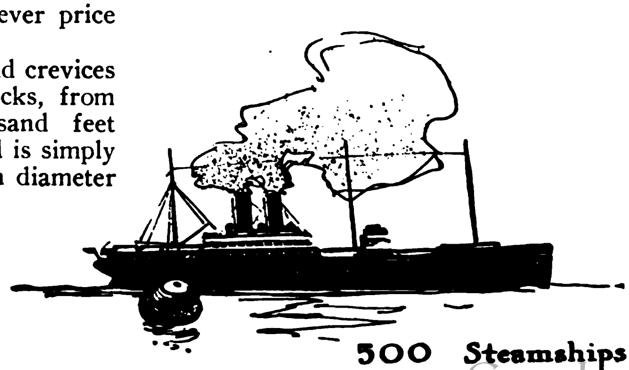


competitor to go into business on a large scale. The Company also owns and conducts nineteen great refineries which in 1906 produced 30,000,000 barrels of refined oils and naphthas, to say nothing of the millions of barrels of lubricants and millions of pounds of paraffin, wax and candles. More than half of its refined oils are sent abroad. The rest is sold from about thirty-five hundred distributing stations in the United States, tank wagons working from each of these stations.

In the truest sense, the Standard Oil Company owns the earth so far as the deposits of the mineral oil are concerned. Its position towards the producers of crude oil is practically this: "You do the costly experimental work of hunting for oil. When you have found it I will take it away from you at whatever price I choose to pay and sell it to the consumers of the world, at whatever price I choose to charge."

Oil is found in the cracks and crevices of certain kinds of porous rocks, from three hundred to two thousand feet below the surface. An oil well is simply a hole in the ground a foot in diameter at the top and six inches at the bottom. Through this long tube the oil is pumped. An oil well is bored by a steel drill weighing with its fittings about a ton and a half. By continually raising and dropping this drill the rock is crushed and is removed by means of a sand pump, a long tube with a valve at the bottom. Sometimes when the oil bearing rock is struck, the pressure under which the oil is confined will send it flying to the top of the well with a rush. More often it is necessary to "shoot" the well. Sometimes as much as two hundred quarts of nitroglycerin are lowered to the bottom of a hole in "shells." A hundred or more feet of water are then turned into the well to "tamp" the charge. The nitroglycerin is then discharged by means of a fuse. The effect of the explosion is to break up the rock at the bottom of the well and thus make room for the free flowing of the oil. After completion, an oil well is lined with iron piping and — unless a gusher—is connected up with the pump. Very often there is a discharge of natural gas from an oil well. When this is the case the gas is conveyed to the engine which works the pump, so that many gas wells practically pump themselves.

Since oil was discovered in Pennsylvania in 1859, nearly two billion barrels of petroleum have been pumped from



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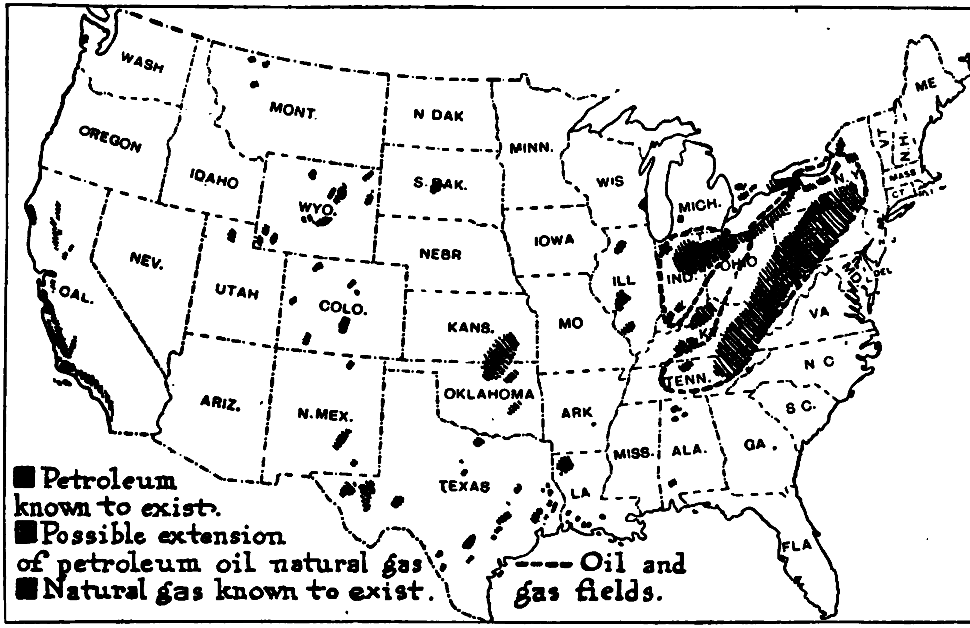
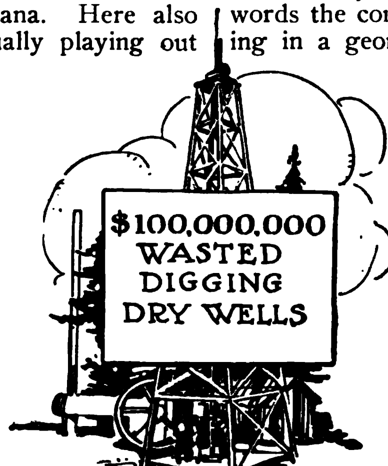


HOW THE OIL AND GAS DEPOSITS ARE DISTRIBUTED IN THE UNITED STATES.

the earth, enough to fill the Panama Canal when completed, twice over. Up to the present time the known oil deposits are confined chiefly to five great fields. The first discovered was the Appalachian field, paralleled with the western flank of the Alleghany Mountains. There the supply is already rapidly becoming exhausted. Already it produces only one-third as much as at the height of its flow.

The second field is known as the Lima-Indiana deposit in northwestern Ohio and eastern Indiana. Here also the deposits are gradually playing out as is shown by the fact that in 1908 out of 1,250 new wells drilled nearly two hundred turned out to be dry holes, while at the same time more than three thousand old wells were abandoned as being no longer productive.

The third field, known as the Illinois and Mid-Continent, covers a small strip of country just west of the Indiana line in Illinois, and larger fields in Kansas and Oklahoma. The Gulf field in Louisiana and Texas and the great California field are of later development and have not yet shown such marked signs of decadence, though there is a distinct falling off in parts of Kansas, Oklahoma and Texas.



Up to the present time the statistics of the oil industry show that in each succeeding period of nine years as much petroleum is pumped as was produced in all the years preceding it. In other words the consumption of oil is increasing in a geometric ratio, so that while it has taken fifty years to reduce the Pennsylvania fields to one-third of their former production, it is practically certain that in much shorter time the other great deposits so far located will be depleted.

The total deposits of petroleum underlying the territory of the United States are roughly estimated by the experts of the gov-

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ernment service to amount to twelve billion barrels, of which one-sixth has already been used. If the present rate of increase continues, as it doubtless will, practically all of the now known deposits will be exhausted in less than one hundred years.

The question of the proper conservation of the oil supply is most complicated. From the standpoint of society probably the most important use of petroleum is as an illuminant in sparsely settled communities. Up to the present time the kerosene lamp furnishes the cheapest light, quality considered, which has yet been produced. Within the last few years vast quantities of crude oil have been used for fuel, particularly on the Pacific coast, where coal deposits are rare, and the tendency is to use petroleum more and more in the fire-boxes of steamships and railroad locomotives. Whether the use of oil for other than illuminating and lubricating purposes should not be somewhat restricted is a question now causing serious discussion.

Jeanie Morrison

I've wandered east, I've wandered west,
Through many a weary way;
But never, never can forget
The love of life's young day;
The fire that's blawn on Beltane e'en,
May well be black gin Yule;
But blacker fa' awaits the heart
Where first fond love grows cool.

O dear, dear Jeanie Morrison,
The thochts o' bygane years
Still fling their shadows owre my path,
And blind my een wi' tears!
They blind my een wi' saut, saut tears,
And sair and sick I pine
As memory idly summons up
The blythe blinks o' langsyne.

—William Motherwell.

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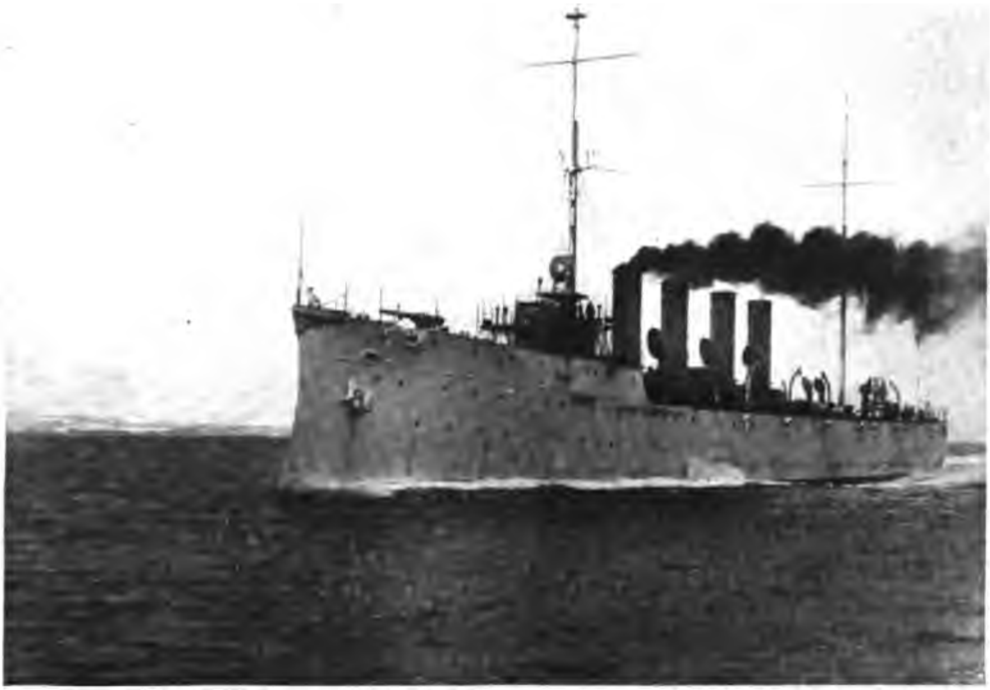

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THE *CHESTER*, BUILT FOR SCOUT SERVICE IN THE UNITED STATES NAVY.
This vessel is equipped with turbine engines of British design.

TURBINE ENGINES WIN

By J. F. SPRINGER

THE long expected race between the scout vessels *Birmingham, Chester* and *Salem* of the United States Navy has at last taken place. This culminating contest, following others of a lesser order, may become a notable event in steam-engine history. And for noteworthy reasons. These three fast ships have been built along what are practically identical lines. The only real difference lies in the propelling equipment. The *Birmingham* is fitted with the usual reciprocating engines. They represent the present highly perfected stage of development of a type that is about two hundred years old. Within these two centuries has been crowded nearly the entire bulk of all the advancement in the application of machinery made within the bounds of civilization. Almost without a rival, the steam-engine has reigned. And, until very recently, about all the practical steam-engines that the world has seen have been of the reciprocating type. This is one significant fact. Another is that the century through which we have just passed has witnessed a greater application of steam power—both in number and total magnitude of installations—than that of any and all kinds of power during the whole

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of preceding history. With these two facts in mind we may well believe that the reciprocating steam-engine is now nearly as perfect a piece of apparatus as it is possible for it to become. The *Birmingham,* then, represents well nigh the utmost limit of perfection along one particular line of development. The steady throb, throb, throb of her magnificent engines, whose energy is equal to that of 15,000 horses, marks the to-and-fro movement of a wonderful piece of apparatus. It is the outcome of a tremendously intense and marvelously sustained effort of human genius. But little more is to be expected of the reciprocating engine.

BLADING OF PARSONS TURBINE. SHOWING SHROUDING AND THINNING OF BLADE TIPS.

The power equipments of the *Chester* and *Salem,* on the other hand, represent a new rival. The turbine steam-engine as a practical prime mover is a thing of but a few years. The original invention, indeed, dates back two millenniums ago. But no real effort at its development was made until quite recently. The fact, then, that the turbine engine has, in the space of a very inconsiderable number of years, placed itself in real, active competition with the older and very highly developed type could scarcely mean anything else than that it involves fundamental principles of the highest value. There must be a wonderful germ somewhere—else whence so much fruit in so short a time?

The final race and the preceding contests represent, then, the struggle of the youth against the seasoned veteran—of a David against a Goliath. The combat on the Palestinian soil three thousand years ago was short and decisive. Not so the battle of the engines today. One fight will not irrevocably decide the issue.

But the contests between the scout ships involve another question. The turbine engines on the *Chester* are of British design—those on the *Salem* are the fruit of American genius. So, then, in a sense, we have in these trials not only a struggle of the old type of engine against the new, but of the Old World against the New. Each of the turbine ships has thus had a double contest on her hands. The *Birmingham,* on the contrary, has had to represent but a single idea—the reciprocating engine.

The final contest which began at 10:45 A. M., April 12, and continued for twenty-four hours was a trial of speed. The ships were known to be fast, the *Birmingham* having previously averaged 24.33 knots on a four-hour run, the *Salem* 25.95 knots, and the *Chester* 26.52 knots. The turbine vessels had thus a speed rating very similar. The *Birmingham's* record was considerably lower. There was this to be said, however: The coal used when this latter vessel's speed trial was made was "run of the mine," while that consumed on board the turbine vessels was "hand picked." The weather was fine overhead and the sea moderate. The start was made from the entrance to Newport (R. I.) harbor, the vessels being separated from each other by intervals of about three miles. A southerly course was then pursued until the fortieth parallel was reached, when the ships turned westward until they came off Atlantic City on the New Jersey coast. They then ran back and forth. When about half the race had been run, the *Birmingham* was compelled to drop out, her starboard engine having become disabled. The race from then on lay between the two turbine vessels. The *Chester,* on which were

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installed the English turbines, Parsons' design, had already confirmed her previous record by leading both her competitors. And so the race went on between her and the *Salem,* on which were the American turbines, Curtis' design. When the final moment of the twenty-four hours came, it found the *Chester* far in the lead. The exact distance ahead was 12.8 knots. It is to be regarded as a great victory, and while it may not definitely settle the relative merits of the Parsons and Curtis designs, it does so, apparently, for the time being.

Nor are we to regard the *Birmingham* as having been finally disposed of, even in this matter of speed. And yet that is certainly what is foreshadowed. She was beaten in 1908 by both the turbine cruisers. The *Salem* led her by 1.62 knots per hour, and the *Chester* by 2.19 knots. But the trials which immediately preceded the recent twenty-four-hour run at top speed were in the *Birmingham's* favor. These trials were largely for the purpose of ascertaining the coal consumption upon long distance runs. Last year, in the standardization runs, the *Birmingham* lost to both her rivals in the two twenty-four-hour runs—one at 12 knots, the other at 22½ knots. She won strikingly, however, in the matter of coal consumption in the four-hour top-speed contest. The turbine vessels kept pretty well together

Curtis Turbine Bucket Segments.

throughout those trials in point of economy—or extravagance, as you choose to look at it—of coal. So when the time came for the three trials in the weeks just preceding the final top-speed contest, the result could not be foreshadowed. It was anybody's race. However, in all three trials—100 hours at 10 knots per hour, 50 hours at 15 knots, and 100 hours at 20 knots—the *Birmingham* showed herself the most economical of the three vessels. The *Salem* was badly beaten in economy by both her rivals in all three trials. In the final economy run at high-speed—20 knots per hour—the difference in coal consumption between the *Chester* and the *Birmingham* was trifling.

The general result may be summed up thus. The *Chester* is the swiftest vessel. For the present, at least, the new type of engine has won over the old, and the Old World against the New. So much for

Horizontal Curtis Steam Turbine Set in Engine Room of the *Hendrick Hudson*, One of the Two Largest River Steamers Plying Between New York City and Albany.

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speed. In point of coal economy, the question is not entirely clear. For the moment, however, we must regard the *Birmingham* as the victor. The American turbine has passed under a cloud both as regards speed and economy. However, we must not forget her standardization trials last summer, when in point of economy she kept close to the *Chester*. And in the final twenty-four-hour top-speed contest, the *Salem's* appetite for coal was not much beyond that of the other turbine vessel. Of course, in the matter of speed, the laurels belong to the *Chester*. She won, no doubt, because her engines were, for the time at least, better than those of the *Salem*. But this is not a final determination of the question of the comparative merits of the two designs.

THE TURBINE-PROPELLED SCOUT CRUISER *SALEM*.
The driving machinery of this warship is of American make.

The well-known reciprocating engine derives its energy from the expansion of steam. This is likewise the case with the turbine engine. The reciprocating type is so-called because it delivers its energy in a to-and-fro mechanical movement. This is a considerable disadvantage from the fact that power is not usually desired thus. Consider a moment. Nearly all the machines which you have observed are driven by rotary movements. In the machine shop, the line-shafting is rotary driven. The driving impulse at the individual machines is delivered in a rotary manner. On board the steamship, the propeller-shaft or the side-wheel-shaft is rotary driven. Only in a few situations is a back-and-forth motion desired. Thus in a certain pumping apparatus for mines, it is advantageous to receive the power in the form of a reciprocating motion. But this is not the case in the vast majority of cases. Almost universally power is desired in the form of a turning movement. With the reciprocating type of engine, the back-and-forth movement of the piston-rod must be converted into the desired rotary motion. With the turbine engine, on the contrary, the move-

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ment is generated in a rotary form. Consequently, it is even possible, when otherwise advantageous, to mount the engine on the very shaft to be turned. This is exactly what is done in marine installations. The rotating parts are secured to the propeller-shaft. This possibility of immediately deriving rotary motion from the turbine is one of the in extensive use. There is no difficulty in getting the rotary motion. In fact, one of the great disadvantages of this type consists in the extraordinary speeds developed. Thus a De Laval turbine of 300 horse-power and having a bucket wheel of about 27 inches in diameter has developed a rotational velocity of about 11,450 revolutions per minute. This

THE *BIRMINGHAM*, EQUIPPED WITH RECIPROCATING ENGINES.
She has been surpassed in speed by the turbine-propelled steamers, *Chester* and *Salem*.

fundamental reasons, no doubt, why it has so soon become a great factor in steam-engine design.

Precisely as a rushing or falling stream of water turns the undershot or overshot water-wheel, so the current of steam rotates the turbine wheel. The turbines in the hull of the *Salem* operate upon this principle. They are, in fact, impulse turbines. Now, of course, we could design a turbine by arranging the "buckets" on the side of the wheel instead of on the edge. The De Laval turbine is so constructed. This has been a very successful apparatus and is now means nearly 200 complete turns per second. A particle on the periphery of this wheel would be moving at the rate of more than fifteen miles per minute, or nearly the velocity of points on the terrestrial equator. The centrifugal force becomes a great factor. Not only is it a question whether the wheel will hold together, but there is the very troublesome problem of balancing the wheel. You see, if one portion of the wheel weighs slightly more than another, there will arise at such great velocities a very highly unbalanced condition of the shaft. The shaft will tend to

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bend until equilibrium is restored. But, even with this problem solved by the use of a long shaft permitting flexure, the high velocity still remains. For certain uses this is an advantage, and so electrical apparatus and cream separators have been successfully constructed on these principles. It is a great question—what shall be done with the high velocities? For most uses power is not wanted in this form. To reduce by any system of gearing hardly seems feasible.

Now the Curtis and Parsons types meet the case differently. The steam is not permitted to accomplish its full expansion at once. It is conducted, just as in the De Laval engine, to the side of a wheel and there permitted to operate upon buckets. But these buckets have no "bottom"—that is to say, they open also upon the other side of the wheel. When the steam gets through, it is by no means expanded to the exhaust point. So instead of being wasted it is conducted through guide openings, somewhat similar to the revolving buckets. But these guides are stationary, and perform the office of so directing the steam that it may be used upon a second set of buckets arranged upon another rotating wheel. And so it goes—the steam alternately passes through rings of rotating buckets and rings of stationary ones. The rotating buckets communicate their rotation to the shaft, and thus rotating power is developed.

Turbine engines have been found well adapted for multitudes of uses. For swift ships they are peculiarly suited, as we have found. They are often used for electric light purposes in connection with plants where the old reciprocating types are installed for the generation of power. Thus, one of the illustrations shows a Curtis apparatus in the engine room of one of the largest—if not the very largest—river steamships in the world.

June

And what is so rare as a day in June?
Then, if ever, come perfect days;
Then Heaven tries the earth if it be in tune,
And over it softly her warm ear lays.

—Lowell.

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THE BURCH AUTO SLEIGH AND PARTY.

NEW AUTO FOR SNOW TRAVEL

By W. T. PROSSER

BY applying the principle of the auger, or using what might be termed an elongated propeller, Charles Burch believes he has conquered the problem of winter travel in the Far North. He has constructed an automobile sleigh which traverses the ice and snow with apparent success, after many devices designed for the same purpose have failed. Burch's vehicle makes from ten to twenty, and even thirty miles an hour, with apparently little regard to the nature of the roadway, just so there is ice or snow beneath its curved runners.

If time demonstrates that the auto sleigh is practical for general utility in Alaska and the Canadian North the possibilities for its use are unlimited, during seven months of the arctic winter. The great difficulty now is transportation during the dark season. In summer, river or coastwise boats can reach within a comparatively short distance of any of the great gold camps, while railways are becoming an aid to the traveler, but the immense distances to be traversed in winter open a wide field for the use of the new means of locomotion. Mr. Burch and his friends who have witnessed the demonstration of his practical model assert that it contains a principle of motion which will revolutionize transportation up under the polar lights.

For several years Mr. Burch has been at work on his auto sleigh. His first models were crude and clumsy, but his later piece of mechanism works to advantage. The fore part of the sleigh rests upon a runner, which serves as well to guide the vehicle. The driver sits before an automobilist's wheel. The auto engine of twenty horse-power operates upon two propelling augers which turn in opposite directions, producing a resultant forward motion. The gearing is such that, compared with an automobile of the same inward mechanism, the speed of the auto sleigh is seven feet to the roadster's nine.

The first lengthy trial trip of the auto sleigh was made from Carcross, B. C.,

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THE BURCH AUTO SLEIGH ON THE ROAD.

to Atlin, a distance of forty-five miles, and back. The ninety miles required ten hours. The condition of the roadway seems to make little difference, and the sleigh goes up hills with apparent alacrity. Also it digs into the smooth ice and crusted snow, making as good progress as upon a beaten path. The screw-like runners are three and one-half feet in diameter. The sleigh was made in the Atlin country, which is in northern British Columbia, not far from White Pass and the headwaters of the Yukon River.

"Our machine has gone through banks of snow four feet deep, and is proving a success in every way," said Frederick Burch, a brother of the inventor, in Seattle recently. "In Alaska and the upper Yukon district almost all winter

PLOWING THROUGH THE SNOW.

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travel is accomplished with teams of dogs. At best progress is slow indeed—this method of transportation has not improved in thousands of years. Again and again have attempts been made to devise an automobile sleigh that would meet practical conditions, but up until now without success. The recent antarctic polar expedition was equipped with a bob-sled provided with a corrugated drum between the bobs, but as this drum revolved, it piled the snow up beneath the sleigh, and rendered the conveyance useless. It was cast aside for the dog teams.

"This machine is practical because it will make the speed," said a member of the party, "and will not be overcome by ordinary conditions. In the interior of Alaska the snow seldom reaches a depth of more than one or two feet. This is no barrier whatever, and travelers can be protected in the enclosed body of the sleigh against the low temperatures of the Far North. We can make a speed of twenty or thirty miles an hour, under favorable circumstances, and plan to establish stage lines on the principal routes of travel as soon as we can manufacture the machines."

THE ARRIVAL IN ATLIN, BRITISH COLUMBIA, MARCH 18, 1909.

Life's Philosophy

Whoe'er has travell'd life's dull round
Where'er his stages may have been,
May sigh to think he still has found
The warmest welcome at an inn.

—WILLIAM SHENSTONE.

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HUGE VIADUCT FOR CONTINENTAL RAILWAY

STARTING from the east bank of the Bow River, in Southern Alberta, the viaduct herewith illustrated, which is one of the largest of its kind in the world, is being carried across the deep valley which has been cut through the rich alluvial deposits of the foothills of the Canadian Rockies. Ahead of the steel legs come the stepping stones, huge monoliths of concrete carried on nests of piles driven to rock. A small town has grown up at the east end, where the workmen employed make their homes. At the same point is a miniature bridge building plant where the sections, some of them 130 tons in weight, are assembled.

The traveling erecting crane is almost a thing of rational thought and life, combining as it does the functions of the locomotive, self-contained power plant, air compressor, hydraulic riveting machine, crane and a dozen other utilities, but back of it all is the guiding hand of man, which controls each move. Crawling slowly back to the storage yard this monster reaches out its many-fingered hands to pick up one of the slender sections of the pier. Back it goes and as an elephant piles teak wood in the sludgy marshes of Ceylon, so this section is lowered carefully and accurately to its appointed position. Then back again to bring in its great claws one of the plate girders, one hundred feet in length and over a hundred tons in weight, which is slowly advanced across the three hundred foot opening, bridging it to a nicety.

Completed, this viaduct will form one of the most important links in the great chain which the Canadian Pacific Railway Company is forging to carry the traffic between Chicago, St. Paul and Minneapolis to the Pacific coast. Through trains now run from the Twin Cities to Seattle, and with this section it will give the company an easy freight route ready to enter the field against its great competitors to the south. The line taps a country rich in timber, coal and minerals, while to the eastward lies a magnificent farming country, a large portion of which may be readily irrigated. The coal output is now about 10,000 tons daily and this may be readily doubled so that this line should pay big dividends.

ERECTING GANG AT WORK ON THE TRAVELING CRANE AT THE LETHBRIDGE VIADUCT, SOUTHERN ALBERTA.

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NEW MOTOR RAILROAD CAR FOR PRUSSIAN RAILWAYS

THE Prussian State Railways are introducing motor cars which will be used in connection with the suburban service of medium sized towns as feeders in stations passed through by express trains. As a single motor car is quite sufficient for these purposes, accumulator operation was found most suitable.

The new car is a double vehicle made up of two short-coupled double axle cars, each of which contains in an extension, a special accumulator battery. As the battery compartments are thus entirely separated from all the remaining rooms —both from the travelers' compartments and the operator's cabin—the most serious disadvantage of electric accumulator operation on railways, viz., the risk of the sulphuric acid vapors damaging the car and troubling the passengers has been avoided most efficiently.

The double car accommodates one hundred passengers, one-half being arranged as a third class coach and the other half as a fourth class coach; each half comprises a driver's cabin which, just as in the case of street cars, affords the only access for travelers to the car interior.

The electrical equipment has been designed with a view to ensuring a maximum simplicity and durability, so as to prolong its life as far as possible, even in the case of rough handling, those cars having to serve even at a considerable distance from the centers of superintendence and the main railway shops. This equipment comprises two series-current motors connected up in series or in parallel by two controllers. In designing the latter, the latest achievements of electric railway engineering have been utilized, the motors being constructed as reversing-pole motors while the disconnecting parts have been removed from the controller. To increase the speed on the last stage, the field coils have been connected up in parallel with shunt resistances.

THE LETHBRIDGE VIADUCT WHICH IS MARCHING ACROSS THE VALLEY OF THE BOW RIVER. It will be a mile-long and 320 feet high.

PAPER WEARS OUT STEEL

THAT a thin sheet of paper will wear out and destroy machine parts may seem a strange idea, yet such is the case, and the castings shown on the next page will serve to illustrate this fact.

The castings are called dogs and are used on automatic machines to move small sheets of paper. The dogs reciprocate in ways, on the forward stroke pushing the sheet of paper, the thin edge of which comes in contact with the nose of the dog: and on the return

MOTOR CAR FOR PRUSSIAN RAILWAYS.

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CASTINGS WORN BY FRICTION OF PAPER.

stroke sliding under the sheet. In each ten hours the dogs handle in this way about sixty thousand sheets, each of which weighs roughly eight one-thousandths of a pound.

The act of pushing these sheets forward results in a slit or cut in the nose of the dog. These slits as shown above are about one-sixteenth of an inch deep and four thicknesses of paper wide. The photographs show these cuts very well. The casting marked with an X is an unused one.

At first sight this cut would seem to have been caused by the wear of the sharp edge of the paper moving sidewise on the nose of the dog. This, however, is improbable since the sheets are held in such a manner as to prevent lateral movement. Fatigue of the metal is doubtless the cause of the cut. The compressive force set up by the dog striking the sheet of paper, though very small, causes by virtue of its great number of applications a gradual fracture of the metal.

ELECTRICALLY-OPERATED SPRINKLING CAR

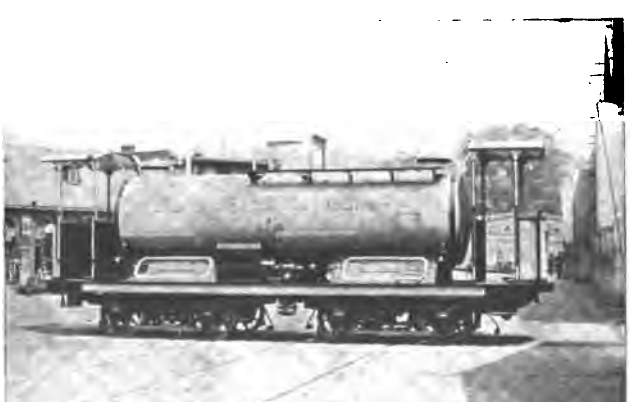
AN interesting electrically-operated sprinkling car, traveling on the tracks of the electrical tramways, has been taken into operation by the city of Cologne, Germany. The sprinkling device comprises two side roses and a rose both beneath the front and back platform. The two latter roses are placed as

OTHER CASTINGS PAPER-WORN.

close as possible to the ends of the car in order to lay the dust already before the passing of the car. The sprinkling devices have been so arranged as to allow the amount of water and sprinkling distance to be regulated.

A pressure regulator, operated from the driver's stand, enables the pressure of the feed water to be altered at will, any surplus water being thrown back into the kettle. As each sprinkling distance corresponds with a given pressure in the sprinkling conduit, the pressure regulator itself allows the sprinkling distance to be increased or reduced within certain limits, while acting as safety valve, the water of its own accord returning to the kettle in the case of an excessive pressure.

The sprinkling car is thus operated at will either with or without pressure according as the drawing outfit is or is not in op-



ELECTRIC STREET SPRINKLER USED IN COLOGNE, GERMANY.

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eration. It is filled in about ten minutes from the ordinary water hydrants.

In order to avoid any disturbance in the operation of the street cars, the motor-driven sprinkling car is run immediately behind a passenger car, traveling at a speed such as to prevent its being overtaken by the following car before the nearest filling station or the terminal of the line. Another advantage of the motor-driven car is that a large surface may be dealt with in a relatively short time by a limited personnel.

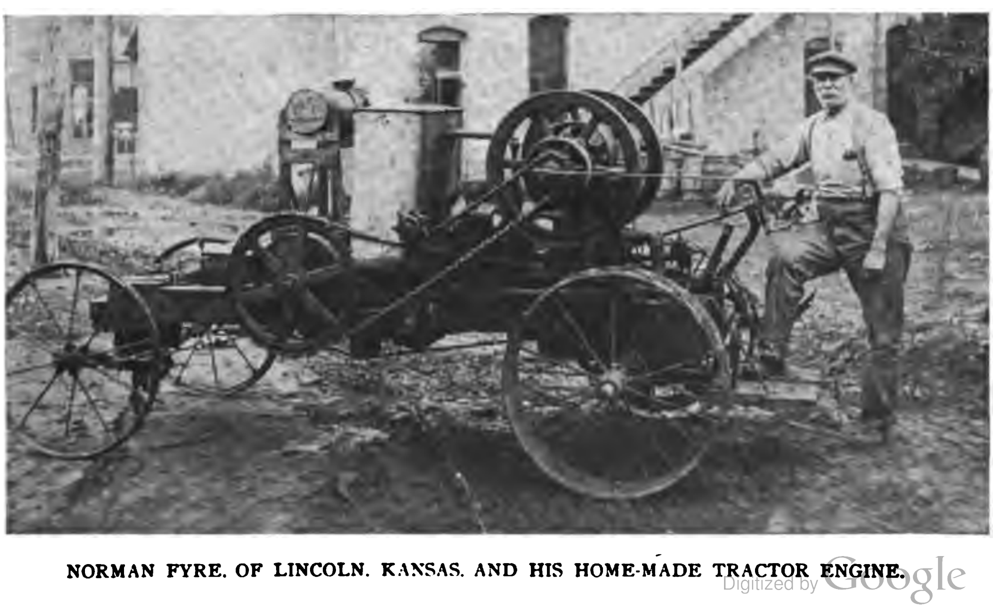
TRACTOR ENGINE HOME-MADE

THE accompanying illustration shows a small gasoline tractor constructed at Lincoln, Kansas, by Norman Fyre. The vertical engine employed has the cylinders in the base with the fly wheels on top and mounted over the real axle with a friction clutch and chain transmission to a countershaft near the center of the tractor frame. It will be noted that the carbureter, steering wheel, and friction clutch lever are all within handy reach of the operator, who stands on the rear step. The gasoline tractor is gradually replacing the horse for a large part of the work on the farm. Also it is being extensively employed for supplying stationary power for cutting feed, for churning, sawing wood and other similar service.

MINE PLANTER.

TUG-BOATS LAY SUBMARINE MINES

RECENTLY, under the direction of United States army officers, four mine-planter vessels were constructed at Jersey City. Their destination is the Pacific, a trip of 10,000 miles. The purpose of the little flotilla is to teach the coast artillery how to lay submarine mines, by filling a harbor channel with gun cotton, and the way to place submarine wire fences that will obstruct battleships even of the *Dreadnaught* type. There are but four of these mine planters now complete, but during the coming summer four more such vessels will be ready to put in commission.



NORMAN FYRE, OF LINCOLN, KANSAS, AND HIS HOME-MADE TRACTOR ENGINE.

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When Diplomacy Failed

MISTRESS—"Bridget, it always seems to me that the crankiest mistresses get the best cooks."

COOK—"Ah, go on wid yer blarney!"—*Illustrated Bits.*

More to the Point

IN a certain restaurant the electric lights were suddenly extinguished. When they were turned on again after a few moments, a lady whispered to her companion:

"Somebody kissed me!"

"Yes, and somebody took my veal cutlet!" replied the other bitterly.—*Bohemian Magazine.*

What Helped

"A CASE of love at first sight, eh?"

"No, second sight. The first time he saw her he didn't know she was an heiress."—*Boston Transcript.*

Convinced

"You are charged with larceny. Are you guilty, or not guilty?"

"Not guilty, judge. I thought I was, but I've been talkin' to my lawyer, an' he's convinced me that I ain't."—*Catholic News.*

A Problem

"WHY are you so sad?" an acquaintance asked a young man whose aunt had just died. "You never appeared to care much for the poor old lady."

"I didn't," said the youth dolefully, "but I was the means of keeping her in a lunatic asylum during the last five years of her life. She has left me all her money, and now I've got to prove that she was of sound mind!"—*Pittsburg Observer.*

Disliked the Other Kind

PHILANTHROPIC CALLER (with subscription paper)—"I shall ask your attention only a moment, sir. Are you a friend of the dumb brutes?"

SHORTY MCGINNIS—"You bet I am! That's why I hate cats, parrots, an' donkeys."—*Chicago Tribune.*

His Hint Failed

CURATE (who struggles to exist on £120 a year with wife and six children)—"We are giving up meat as a little experiment, Mrs. Dasher."

WEALTHY PARISHIONER—"Oh, yes! One can so well live on fish, poultry, game, and plenty of nourishing wines, can't one?"—*Punch.*

Sufficient

HUSBAND—"You never kiss me except when you want some money."

WIFE—"Well, isn't that often enough?"—*Judge.*

The Hipless Age

FROM lovely woman's wiles we find
That there is no escape;
She's not content to change her mind,
But now she's changed her shape.
—*Lippincott's.*

A Trying Time

JUDGE—"Why did you strike this man?"

PRISONER—"What would you do, judge, if

you kept a grocery store and a man came in and asked if he could take a moving picture of your cheese?"—*Harper's Weekly.*

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At the Bar

"JUDGE, did you ever try an absinthe frappé?"

"No; but I've tried a lot of fellows who have."—*Cleveland Leader.*

A Good Tip

ONE way to make your wife's biscuits taste like mother's did, is to buy a bucksaw and saw wood an hour before supper.—*Herald and Presbyter.*

Just in Time

"I SUPPOSE," said the casual acquaintance, the day after the wedding, "it was hard to lose your daughter."

"No," replied the bride's father. "It did seem as if it was going to be hard at one time, but she landed this fellow just as we were beginning to lose all hope."—*Pittsburg Observer.*

In the Divorce Colony

THE little De Jones girl is talking to her playmate, Lucy van Smith.

"Oh, Lucy," said she, "we have a new papa!"

"Have you? What's his name?"

"Mr. Hayes."

"Oh, pshaw! we had him, too, but we didn't like him."—*Lippincott's.*

The Other End

MAGISTRATE—"You say you want a divorce because your married life is one long series of fights. You don't look it."

WOULD-BE-DIVORCE—"No, your Honor, but you ought to see my wife."—*The Circle.*

The Trouble

FRIEND—"Don't worry because your sweetheart has turned you down since you lost your money. There are as good fish in the sea as ever were caught."

JILTED ONE—"Yes, but I lost my bait."—*Harper's Bazar.*

Cause for Anxiety

THE baby was slow about talking, and his aunt was deploring that fact. Four-year-old Elizabeth listened anxiously.

"Oh, mother," she ventured at length, "Do you think he'll grow up *English?* We couldn't any of us understand him if he turned out to be French!"—*Lippincott's.*

Perfectly Tickled

GREAT LADY—"So sorry! I'm afraid my feathers were tickling you during the lecture."

VERY MUCH LESSER LADY—"Oh! dear Lady High-bridge-Knowsley, who would mind being tickled by you?"—*Punch.*

His Duty

THE LADY—"Look here; you said that if I'd give you your dinner you'd mow the lawn for me."

THE HOBO—"I'd like to do it, ma'am, but I gotter teach yer a lesson. Never trust th' word of a total stranger."—*Cleveland Leader.*

Successful Ad

SEVERAL weeks ago a Kansas editor advertised the fact that he had lost his umbrella and requested the finder to keep it. He now reports: "The finder has done so. It pays to advertise."—*Kansas City Journal.*

Unfortunate

HOUSEWIFE—"If you love work, why don't you find it?"

BEGGING TRAMP—"Love is blind, ye know."—*Judge.*

A Straight Tip

JOHNNIE (to new visitor)—"So you are my grandma, are you?"

GRANDMOTHER—"Yes, Johnnie! I'm your grandma on your father's side."

JOHNNIE—"Well, you're on the wrong side, you'll find that out!"—*Philadelphia Bulletin.*

His Business?

NURSE (announcing the expected)—"Professor, it's a little boy."

PROFESSOR (absent-mindedly)—"Well, ask him what he wants."—*Boston Transcript.*

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MONUMENTAL SOUVENIR OF EARTHQUAKE

AT the time of the great San Francisco earthquake of April, 1906, immense damage was done to the various large cemeteries near the city. The total havoc in these places was estimated to reach half a million dollars. Soon after the disaster, the work of repair and rehabilitation was commenced, and continued until things were as before. There is, however, one notable exception, and that is in the Laurel Hill Cemetery.

There is a handsome tombstone occupying a prominent position, which was badly shaken by the earthquake. The heavier stones composing the foundation were not displaced by the violence of the shock, but the upper parts were twisted out of position. It has remained untouched from the day of the shock to the present.

This has been due to the fact that the estate of the person whose ashes are thus so strangely marked has been long in litigation. The litigants have been too much engrossed in the estate matter to pay any particular attention to the present damaged condition of the tombstone.

A MONUMENT TO THE CALIFORNIA EARTHQUAKE OF 1906.

WHERE SLAVES WERE SOLD

IN these days it seems hard to realize that less than fifty years ago human beings were commonly dealt in as merchandise over a large part of the United States. The fact that such was the case, however, is rendered interestingly vivid by such a photograph as the one herewith presented on the following page, which was taken in Charleston at the close of the Civil war. It represents the establishment of a firm, Price, Birch & Co., engaged in business as "Dealers in Slaves"—so says the sign over the front door.

Adjoining the store, wherein men, women, and children were the merchandise disposed of, is a large enclosure containing temporary quarters for the negroes awaiting sale—the wall surrounding it being, as will be noticed, very high, to prevent escape.

To illustrate further the fact that such human beings were dealt in substantially on the same principles as any other kind of live stock, it is permissible to reproduce herewith a letter from another firm of slave dealers, D. M. Pulliam & Co., at Richmond—the original being one of the curiosities preserved in the house at Washington wherein Abraham Lincoln died. It is as follows:

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Richmond,
Sept. 15, 1857.
William Cox, Esq.
Dear Sir:

The following is the state of our negro market today:

No. 1 Men (Extra), $1450 to $1550; No. 1 Men (Good), $1200 to $1250; No. 2 Men (Common), $1100 to $1150; No. 1 Women (Extra), 16 to 22 years old, $1200 to $1250; No. 2 Women (Good), $1000 to $1050; No. 2 Women (Common), $925 to $975; No. 1 Boy four feet high, $500 to $550; No. 1 Boy four feet three inches high, $625 to $675; No. 1 Boy four feet nine inches high, $900 to $1000; No. 1 Boy five feet, $1050 to $1150; No. 1 Boy five feet six inches high, $1200 to $1250; No. 1 Girl, four feet high, $500 to $550; No. 1 Girls four feet three inches high, $625 to $650; No. 1 Girl four feet six inches high, $750 to $800; No. 1 Girls four feet nine inches high, $900 to $975; No. 1 Girl five feet high, $1000 to $1075.

Families and scrub sell in their usual proportion to above quotations. We would be pleased to see you down soon with a likely lot. Very truly,

D. M. Pulliam & Co.

A curious comment on a civilization.

A Slave Dealer's Establishment in Charleston. Fifty Years Ago.

MALE OR FEMALE—WHICH?

RECENTLY in London there was submitted to public test a curious scientific instrument called a Sexaphone—the invention of a working engineer named Williams—the object of which is to determine the sex of all animate and some inanimate objects, including human beings and eggs. The apparatus is of a most simple character, and consists of a copper wire and a piece of magnetized steel, at the lower end of which is suspended a pith ball. At the opposite end is a wooden handle inlet with copper, which is held in the center of the palm. The pith ball, when the instrument is held over the object to be operated on, will either gyrate or swing like a pendulum. If it gyrates the object is a male; if it swings, a la pendulum, the sex is feminine. Some amusement was caused when the apparatus was held over the heads of several well known people in the audience, but it never once failed in revealing the sex—now swinging in circles when "covering" a gentleman and anon acting like a pendulum in the case of a lady. Several animals were successfully operated on. Once the in-

Testing the Sexaphone Over the Head of a Rabbit.

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EXPERIMENTAL CONCRETE LAMP POST.

strument was held above a dog (concealed in a basket), the sex of which was known only to the owner. The pith ball swung in circles, at first slowly and afterwards with some violence, thus showing that the animal belonged to the masculine gender. Still more interesting were the tests made with eggs, the fertility or non-fertility of which the inventor claimed he could determine. Five eggs were produced and after "covering" them with the Sexaphone the inventor declared that three were males and the other two "doubtful," the instrument, in the latter cases, at first gyrating and then swinging in pendulum fashion.

This is another of those curious devices which have mystified the scientists. Various explanations have been given, but none of them seems quite satisfactory.

LAMP POST OF CONCRETE

THE photograph herewith shown is of an experimental concrete lamp post which is being tried in Washington, in the residential districts.

The columns are fluted with an Ionic capital and give great beauty to the street. They are placed one hundred feet apart alternating on each side of the street.

Different globes are being tried, those of clear glass, frosted and the so-called "rotten" glass.

A single 32 candle-power incandescent globe furnishes the light.

A CURIOUSLY HUMAN DEVICE

NO more interesting or remarkable claimant to attention in the field of scientific invention than the Dictograph has come before the public in recent years. It has been installed in many of the principal banks and business houses of New York, Chicago, St. Louis, Kansas City, San Francisco and other cities, and in several of the government departments at Washington.

The Dictograph is a handsome little box, or as a matter of fact two boxes, one known as the "master station," the other, a smaller box, being the "substa-

PRESIDENT OF A COMPANY DICTATING TO HIS STENOGRAPHER THROUGH THE DICTOGRAPH.

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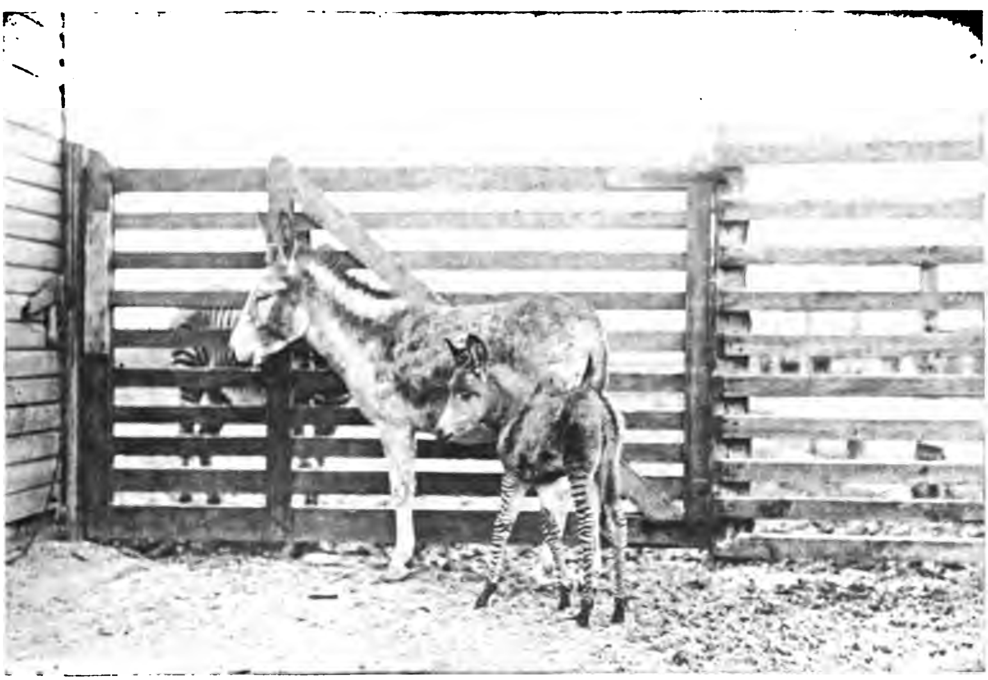
tion." When these two stations—whether separated by a room or a distance of a hundred miles—are connected by wire, the Dictograph is ready to perform its wonders.

You may stand any distance from the instrument within a radius of fifteen feet, at any part of an ordinary room and talk to it as casually as you would to a person in the room. You may speak in low conversational tones or even in a whisper, it makes no difference to the Dictograph.

With the pressing down of the lever a buzzer secures the attention of the person at the other end of the line who responds and conversation begins. To illustrate, suppose the chief instrument to be in the office of the general manager of a great department store, there being connections with the room or desk of every department head throughout the establishment. By pressing down the proper lever the general manager is at once put into communication with any particular subordinate to whom he may wish to give instructions. That in itself is a sufficient merit to commend the Dictograph to the business world. Something truly remarkable, however, is the fact that the general manager can deliver a general order to all of his subordinates at once without calling one of them away from his desk.

BREEDING PRODUCES NEW ANIMAL

HERE is a photograph of some very interesting animals at the experiment station of the Bureau of Animal Industry near Washington. This is one of the first and only pictures taken of the "zebras" recently born. It is the progeny of a Mexican burro and the greavy zebra presented to President Roosevelt by King Menelik of Abyssinia. The Agricultural Department after great difficulty has succeeded in producing this hybrid and expects to find in it and those to follow ideal farm animals.



A STRANGE FAMILY.
The parents of the little hybrid in the foreground are zebra and burro.

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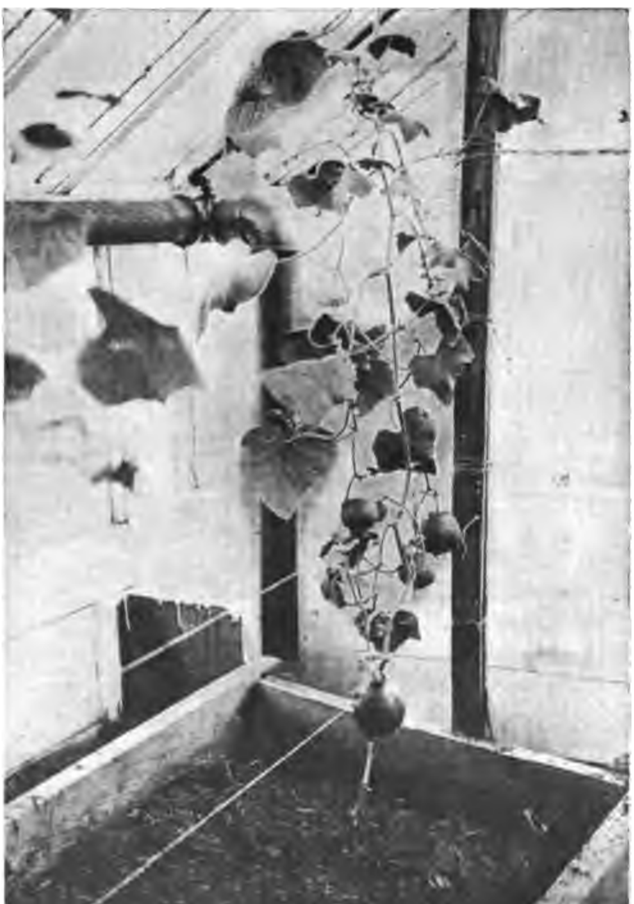
ORANGE-CUCUMBER A NEW PRODUCT

AFTER about two years of careful experimenting, a young Massachusetts horticulturist, Howard S. Hill, of Gardner, has succeeded in producing a remarkable fruit-vegetable, which he calls an "orange-cucumber." He began his experiment by mixing the male pollen of the orange with the female pollen of the cucumber. The result was a strange looking product with an orange taste.

Seen today at this greenhouse as fruit on the vine, the color is much like that of an orange, yet shaded with green. There is the smooth skin of the cucumber, the navel seed bag of the orange, and also seeds in other places, suggesting the cucumber. The combination is a bit more attractive to the taste than the cucumber.



A Specimen of the Orange-Cucumber.

In his last year's experimenting, Mr. Hill mixed the male orange pollen with the female "cuke-orange" pollen, and the result was a still more marked orange sort of cucumber.

Last fall he mixed as before and the present glass-house crop is of almost orange size and shape, the navel being distinct and full of seeds. The section marks of the orange show through the skin but they do not exist within the combination vegetable fruit.

When the product is sliced the texture and composition are still like the cucumber, though the substance is softer, the inner seeds smaller, and to the taste slightly sweet but exceedingly agreeable.

Speaking of his experiments, Mr. Hill says: "At the present time, at the end of the third year, I have upwards of sixty seeds, and propose to raise all these when I put my next crop into the ground. I hope soon to raise seedless cucumber oranges.

"Some time ago, I did produce a seedless cucumber but at the end of the year I found myself at the point where I started, for there were no seeds to plant. It was a contingency I had not reckoned with and I thought Nature had played a rather good joke on me.

"The ordinary cucumber matures in about eight weeks. It took my cucumber-orange ten to twelve weeks to mature fully."

The time seems at hand when Nature's products in their simplest forms will no longer be served, but improved combinations of them.

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CONSULTING DEPARTMENT

Are you puzzled by any question in Engineering or the Mechanic Arts? Put the question into writing and mail it to the Consulting Department, TECHNICAL WORLD MAGAZINE. We have made arrangements to have all such questions answered by a staff of consulting engineers and other experts whose services have been specially enlisted for that purpose. If the question asked is of general interest, the answer will be published in the magazine. If of personal interest only, the answers will be sent by mail, provided a stamped and addressed envelope is enclosed with the question. Requests for information as to where desired articles can be purchased will also be cheerfully answered.

Does It Pay to Pick Up a Nail?

To settle a discussion, please state with figures whether or not it pays to pick up a nail. —*W. D.*

It is claimed that one keg out of five is never used, but goes to waste. Assuming that it takes a carpenter ten seconds to pick up a nail, and that his time is worth 30 cents an hour, the recovery of the nail he has dropped would cost .083 cents. The money value of an individual six-penny nail is .0077, that is, it would not pay to pick up 10 nails if it took 10 seconds of time worth 30 cents an hour. Ordinary men who are not very quick can, however, pick up a nail on a moderately clean floor in five seconds. Assuming that this is a better average than the 10 seconds, and that we are paying the carpenter only 25 cents an hour, it will still cost to recover the nail .0347 cent, which is nearly five times the value of an individual nail. There is, therefore, a considerable factor of safety in the original calculation, and we are bound to believe that it will not pay to pick up nails.

To Lay a Tin Roof With Cleats

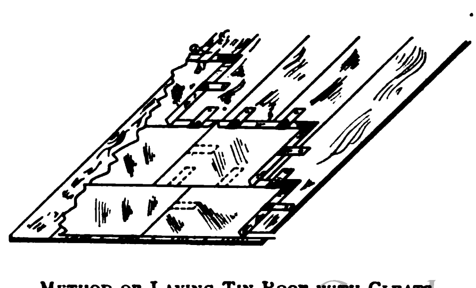
Please tell me how to lay a tin roof with cleats.—*D. S.*

The accompanying sketch shows the method of laying a tin roof with cleats. The cleat *a* is a straight strip of tin about three inches in length and one and a half inches in width. The edge *d* is bent to the same shape as the corresponding edge of the tin plate that locks into it. The edge of the next sheet above overlaps this and covers the cleat. Each sheet has two nail holes and a nail is driven near the opposite end of the cleat as at *c*. The nail is far enough away so as not to effect the expansion and contraction of the sheets and produce strain on the seams. The strips are nailed directly to the boards and are covered by the next sheet. This is an excellent method of laying a roof, as change of temperature will not injure it.

Steam Engine Exhaust Muffler

Can you suggest a muffler to lessen the noise of the exhaust from a steam engine?—*G. E.*

The gas engine is not the only offender in the matter of noisy exhaust. Muffling tanks to minimize the noise of the escape of exhaust steam from high-pressure non-condensing steam engines are sometimes needed. In such cases it suffices to insert near the engine a tank of 15 to 20 times the volume of the cylinder and continue the exhaust pipe from this



METHOD OF LAYING TIN ROOF WITH CLEATS.

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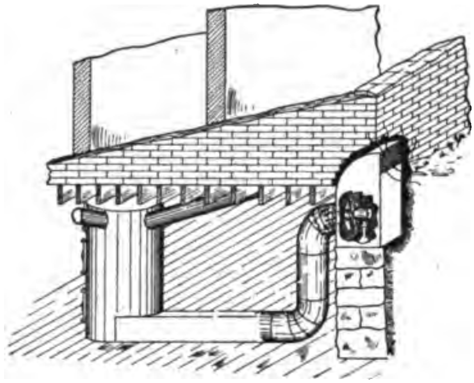
muffler. This will do away with the disturbance caused by high-pressure exhaust steam passing through a tortuous exhaust pipe.



METHOD OF INSTALLING ELECTRIC FAN TO INCREASE DRAFT OF FURNACE.

To Remedy Furnace Trouble

Our house is heated by a hot air furnace. When the wind is wrong we get very little warm air in the room. Can you suggest any way to remedy this?—*H. C. A.*

Probably the best way to remedy this trouble without making changes in the heating installation, is to put an electric fan in the fresh air inlet, so that it will draw air from the outside and force it into the furnace. This will give you forced circulation of air whenever needed. The switch for controlling the fan can be placed inside wherever convenient.

To Construct an Air Pump

Please give me directions how to make an air pump or an equivalent to get a good vacuum.—*P. K. O.*

The simplest way for getting a vacuum is by means of a mercury pump, a device which you could construct yourself.

Referring to the sketch: A denotes a glass bulb which we wish to evacuate. This bulb is connected by the glass cock, b, with the vertical tube, c, which is to be shut off by the glass cock, d, and is connected by means of a long rubber hose, e, with the glass tube, f. Spaces c and e are to be filled with mercury. The cocks must fit very nicely and are to be greased with vaseline so that they close air-tight.

The apparatus works as follows: Hold the rubber hose and glass tube, f, in position indicated by f′, shut the cock b and open d. Lift f′ to the position of f, so that the mercury is raised in c just over the cock d and shut off d. Lower f, causing the mercury in c to fall. Then we create a vacuum above the mercury in the space v. As soon as the mercury level is below b, open and shut off b very quickly. The air contained in A will rush out into the vacuum thus leaving a partial vacuum in A. Now continue the same operations. Open d again, leaving out the air, shut off d, lower f, etc. The air in the bulb A will become less and less until finally vacuum has been obtained.

Beef-Juice the Best

What is the best kind of extract of beef to use?—*R. W. T.*

The government Bureau of Chemistry has been making a critical examination of meat "extracts," meat "juices," and meat "powders." These are articles widely advertised and especially recommended for invalids—whence the importance of ascertaining something definite in regard to their character and make-up.

Up to a few years ago the soup liquor obtained from meats in the process of

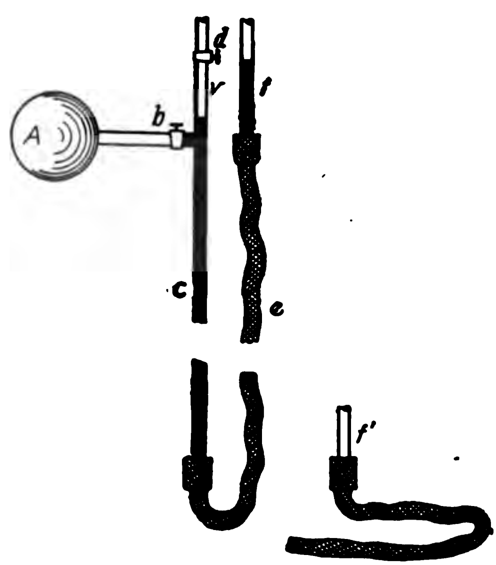


DIAGRAM OF AIR PUMP.

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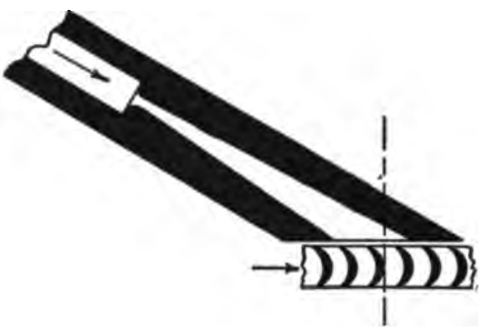
preparing the latter for canning was wasted—thrown away, in fact. Nowadays it is used for making "extracts," the production of which is a very considerably industry.

In preparing meat for canning, it is cut into pieces and placed in iron baskets which are suspended in large tanks containing cold water. Heat is then applied by admitting steam, for half an hour. Then the "liquor" is pumped off into vacuum pans and concentrated until re-



STEAM TURBINE NOZZLE AND VANES.

duced to a semi-solid containing only about twenty-two per cent of water.

First-grade "extract" is prepared from beef alone. The second grade is made from trimmed bones, and from odds and ends of meat and bones, which are heated, not boiled, for thirty or forty minutes, the liquor being thereupon evaporated to a semi-solid.

Manufacturers say that one hundred pounds of soup liquor should yield one pound of "extract." But it is admitted that the product offered in the market is unavoidably inferior to that which can be made in the home or hospital. Beef juice prepared from fresh beef by pressure and long heating at a low temperature is an ideal product, full of flavor and containing much nutriment. Unfortunately, an equivalent is impossible commercially, because the preservation of the stuff in hermetically sealed packages, whether tin or glass, demands the application of high heat, which coagulates the nitrogenous elements. Removal of these elements signifies a loss of the valuable nutritive principles.

As a final conclusion, it is declared that the commercial "extracts" act upon the body more like alcohol than as a food. They stimulate the heart and the digestion, and their flavor promotes the flow of the digestive juices. They have a usefulness in the kitchen on account of their flavor, but not for any contribution they make to the nutritive value of the diet.

Steam Turbine Nozzle of One Stage with Single Effort

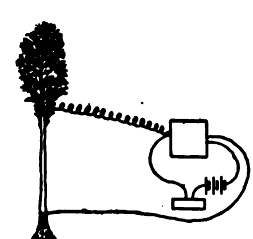
Illustrate a case of a steam turbine nozzle where there is but one stage with a single steam effort.—*E. V. P.*

The accompanying figure is a diagrammatic illustration of such a nozzle and a few vanes of a turbine of the De Laval type. The vanes are mounted on the periphery of a wheel whose axis is shown by the dotted line. Steam is admitted to and expanded in the nozzle, and, with a high velocity, enters the turbine buckets, rotating the wheel in the direction indicated.

Living Trees as Aerials

Why can't living trees be used as the aerial of a wireless telegraph station?—*D. E.*

The principal difficulty in the use of living trees as aerials is their small conductivity. However, there have been some very interesting experiments performed, which go to show that living trees may, within limits, be used for this purpose. The wireless receiving set consisted of a portable outfit, comprising a wave detector and the necessary adjuncts, the aerial wire of which was connected to the foliage of a tree, and the other side to the top just above the roots, as shown in the sketch. The connections were made by driving a long nail into the tree. The sending set consisted of the usual coil and aerial. The tree was 15 feet high, 200 feet from the sending station. The signals were easily heard at this distance. Of course, the results would depend a great deal upon the strength of



TREE EMPLOYED IN AERIAL TELEGRAPHY.

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the sending station and the sensitiveness of the receiving station. These instruments, under ordinary conditions, would work for a few miles, but with the tree as an aerial they worked for a few hundred feet.

To Estimate Length of Pipe in Steam-Heating

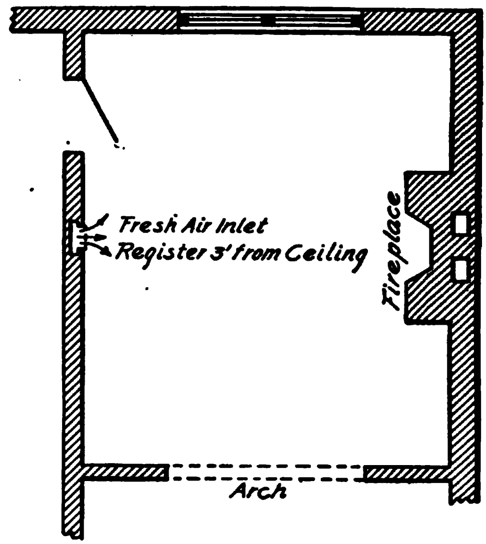
How do you estimate the number of feet of steam pipes to use in steam-heating?—*O. W. J.*

In heating buildings by steam, the kind of building and its location determines to a large extent the amount of boiler and heating pipe capacity necessary. Roughly, however, the number of square feet of radiating surface necessary to heat a room, hall, or building, may be obtained as follows: Add together the square feet of glass in the windows, the number of cubic feet of air required to be changed per minute, and one-twentieth the surface of external wall and roof; multiply this sum by the difference between the required temperature of the room and that of the external air at its lowest point, and divide the product by the difference in temperature between the steam in the pipe and the required temperature of the room. The quotient will be the required surface in square feet. In indirect heating about 75 per cent more radiating surface will be required.

Large pipes are not as effective as small pipes. When the diameter is doubled, 20 per cent additional surface should be allowed, and for three times the diameter, 30 per cent additional is required.

Where the condensed water is returned to the boiler, or where low pressure of steam is used, the diameter of mains leading from the boiler to the radiating surface should be equal in inches to one-tenth the square root of the radiating surface, mains included, in square feet. Thus a one-inch pipe will supply 100 square feet of surface, itself included.

Return pipes should be at least three-fourths inch in diameter, and never less than one-half the diameter of the main, longer returns requiring a larger pipe.



POSITION OF A VENTILATING REGISTER FOR A ROOM.

Position of Ventilation Registers

Where should inlet registers for ventilation be placed in a room?—*A. M. S.*

When no special provision is made for the admission of pure air to a residence, or where the cost of indirect heating seems to make its use prohibitive, there should be at least one fresh-air inlet. This should be placed in the lower, or reception hall, and as great a volume of air admitted as can be tempered by an indirect radiator placed beneath the floor, the size of same depending upon existing conditions. The inlet registers for all ventilation of this character should be placed in the wall at a point about two-thirds the height of the ceiling and they should be located at a point opposite to the fireplace, if there be one in the room, as shown in the illustration.

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A TRAVELING CHURCH AND AN ASSEMBLY OF CHURCH DIGNITARIES.

THE CHURCH ON WHEELS

By HUGH C. WEIR

THE church on wheels is for the town without a house of worship. There are more than 200,000 churches in the United States, but in spite of this fact, there are several thousand communities where there is no church of any creed whatever. It is for these communities that the church on wheels—the railroad chapel — has been primarily designated, and in the Baptist denomination alone, these churches of the rails have traversed more than 125,000 miles.

From an exterior view, the church resembles an ordinary railroad coach. It is not until an interior view is obtained that its real possibilities are digested. St. Andrew's chapel car of the Catholic church will accommodate one hundred worshipers, the seats arranged on either side of a narrow central aisle, facing the altar built at one extremity.

With the altar, which is fitted in the conventional Catholic fashion, is an organ, so that a full church program can be performed with novel effect. At one side of the altar is a small vestry, and at the rear, those sections used as the sleeping and living quarters of those in charge. From the altar to the door is a distance of forty-five feet, a space of twenty feet being devoted to the domestic apartments. These consist of kitchen, dining room and sleeping berths, all of course being built with a constant view to every economy of space.

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INTERIOR OF ROMAN CATHOLIC CHAPEL CAR. "ST. ANDREW."

The car was constructed at a cost of $15,000, and in a period of two years' time has distributed $200,000 toward the erection of new churches in the West and Southwest.

The originator of the chapel car is "Uncle" Boston W. Smith, who is now the overseer of a dozen such cars in all parts of the United States. Much of the expense of the work is borne by the railroads, the cars being transported over all lines free of charge. Often, the church on wheels is side-tracked at a lonely hamlet for a space of six weeks before continuing its journey, the men in charge holding daily evangelistic services, and in several instances seeing work on a local church building started under their inspiration.

It is estimated that over one hundred new churches have been built in this manner, the majority scattered through the sparsely settled regions of the Western states.

The story of the chapel car is not without its tragic features. E. G. Wheeler, the manager of the car known as "The Evangel," lost his life in a disastrous railroad accident. Often the plucky operators have penetrated into the wildest districts of the frontier in spite of the most menacing threats; on several occasions, the cars have been assailed and the preachers have faced ugly showers of missiles.

Among the heaviest contributors to the chapel car enterprise is John D. Rockefeller. Indeed, it was Mr. Rockefeller who made the first railroad chapel possible, and he has followed the development of the idea with keen interest and liberal contributions.

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NEW APPARATUS TO RESCUE THE DROWNING

By DR. ALFRED GRADENWITZ

Berlin Correspondent Technical World Magazine.

A SALVAGE outfit of remarkable simplicity for the rescuing of the shipwrecked, which has been recently designed by Captain Kaumann of the Hamburg-American Line, is composed of six rope ladders—Jacob's ladders, as they are called—fixed to three rings arranged above one another, the lowermost of which is covered over with a net.

The hollow cylinder-shaped cage thus formed is attached to a rope running over the roll of a crane or davit of considerable radius. When folded up, it occupies but little space, and when wanted for use, it is lowered into the water at a moment's notice.

While the process so far demonstrated was limited to throwing out to each of the persons struggling with the waves, tows and salvage rings,—which method obviously was rather inefficient, while taking up an excessive length of time—this apparatus, the rungs of which are readily seized, allow about thirty persons at a time to be lifted out of the water.

In order fully to appreciate the full usefulness of a salvage apparatus like the one above described, it should be

LIFE-SAVING CAGE. SHOWING MANNER IN WHICH IT IS CONTROLLED BY CORD AND PULLEYS.

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remembered that, especially during the Russo-Japanese war, practically the whole of the crew in sinking vessels had to be left to their fate, the task of hospital ships being so far limited to berth-

A DEMONSTRATION OF THE NEW LIFE-SAVING APPARATUS.

ing the wounded after a battle. The new apparatus will allow those vessels to take on board the numberless people drifting in the water, and in this connection will prove the more useful, as warships during a battle dispense with the life-boats, which, being generally made of wood, would be likely to endanger the crew by their risk of splintering and fire.

A hospital ship equipped with this apparatus will have to sail as rapidly as possible to the site of the catastrophe in order to lift on board about thirty persons at a time by means of the rescuing outfit. The net provided at its bottom is intended for accommodating the most exhausted.

Should the number of persons clinging to the apparatus exceed its lifting power, it would have to be taken close to the ship's side by means of the davit, when the crew of the ship will be able rapidly to berth the men struggling with death.

The apparatus has been recently tested on the *S. S. Hansa* of the Hamburg-American line. The merry "shipwrecked" shown in one of the illustrations are members of a Hamburg rowing club who did not hesitate to trust themselves to the icy water in order to demonstrate the possibilities of the new salvage apparatus. The latter is to be adopted also by the large passenger steamers of the mercantile navy. Whenever in a rough sea the crew of the boat is subject to the danger of being crushed on the walls of the ship, the new apparatus is likely to prove especially valuable.

Captain Kaumann has placed both this salvage apparatus and the swinging hospital berth previously invented by him at the disposal of the Germany Navy, free of any charge.

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QUARRYING FOR AMERICAN DINOSAURS

By FRANK MADISON

SURELY a strange occupation, this spending one's days hunting for the bones of animals which roamed the American continent millions of years ago; when this great country of ours was the happy hunting ground for weird monsters of fabulous size and uncouth shape.

Weary months may be spent toiling in regions remote from the world without the reward of a single bone, and then suddenly the face of the prospector becomes radiant with joy, for his trained eye has caught sight of a fossil fragment, which to the uninitiated would be just a piece of dark rock. It is perhaps part of a rich deposit, and eager hands are soon disinterring the massive log-like bones.

Now of all America's mighty family of extinct animals there is none so eagerly hunted as the Dinosaur—that strange link between the fish and the bird. There were numerous varieties of him roaming or flying about the earth in bygone ages, ranging from a little creature about the size and shape of a chicken to colossal beasts forty to eighty feet in length, the greatest terrestrial and semi-aquatic animals that ever lived, weighing anything up to twenty tons. Some kinds there were that resembled the crocodile, while others were more like an ostrich. Some propelled themselves with the hind limb only, and others used both limbs. Some

UNCOVERING THE SKELETON OF A BRONTOSAURUS.

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ate meat, while others were strict vegetarians.

A million or so years ago—one cannot speak very definitely in dealing with the age of prehistoric animals—when the Rocky Mountains were yet unborn, our

UNCOVERING A HIND LIMB OF THE LONG-LEGGED DINOSAUR DIPLODOCUS, NEAR BONE CABIN QUARRY, WYOMING.

bare western plains were a semi-tropical region of splendid lakes, rivers and luxuriant foliage, and was very much alive with these fearsome reptiles. And if only old Father Time could be coaxed into winding his clock back a few aeons and allow us to peep at these earlier Mesozoic scenes, our wondering eyes would behold vast herds of mammoths, mastodons, and dinosaurs trailing their mighty bodies through swamp and reedy forest.

Can you imagine what a fantastic nightmarish sight that would be? Fancy a herd of dinosaurs from forty to eighty, some even one hundred, feet in length, with the limbs and gait of gigantic elephants, but with bodies extending through the long flexible tapering necks into the absurdly small and snakelike head, and stretching away back into the equally long and still more tapering tails.

But the whole mighty army of them disappeared from off the face of the earth ages ago, and the fossil hunter is today busy gathering their remains in many a western canyon. The richest deposits have been found in Wyoming, which is a veritable geological wonderland.

It appears that a Mexican sheepherder had collected some of these petrified bones for the foundations of his cabin. A bone prospector happened along one day, and soon the wires were humming with his discovery. The excavation of a promising outcrop soon brought to light a prodigious thigh-bone six feet long, which sloped downward into the earth, running into the lower leg and finally into the foot, with every part in position just as in life. This proved to be the previously unknown hind limb of the great Dinosaur Diplodocus.

In the removal of the bones the "plaster method" is used. This is surgery on a gigantic scale for the "setting" of the much fractured bones of a fossilized skeleton. The object is to keep all the fragments and splinters of bone together until it can reach the skilful hands of the museum preparator.

The Bone Cabin Quarry, as it is called, is a complete museum of all the animals of the period, the largest dinosaurs lying side by side with the smaller but powerful carnivorous dinosaurs which preyed upon them, also those of the lightest and most birdlike of the dinosaurs. The limbs are found complete from eight to ten feet in length, perfect even to the sharply pointed and recurved tips of their toes, but some are so crushed and distorted by pressure that it is not worth while to remove them. The most likely theory, according to Professor Osborn, as to how all these skeletons came together, is that the site was the area of an old river bar, which in its shallow waters arrested the more or less decomposed and scattered carcasses which had slowly drifted down stream towards it, including a great variety of dinosaurs, crocodiles, and turtles collected from many points upstream. The animals of a whole region were thus brought together.

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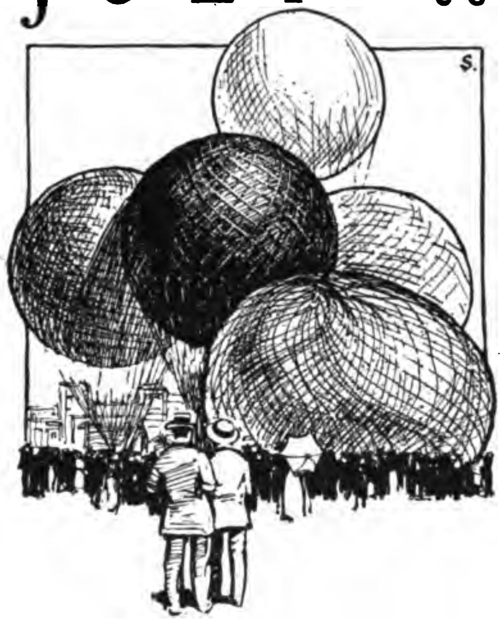
JULY ♌



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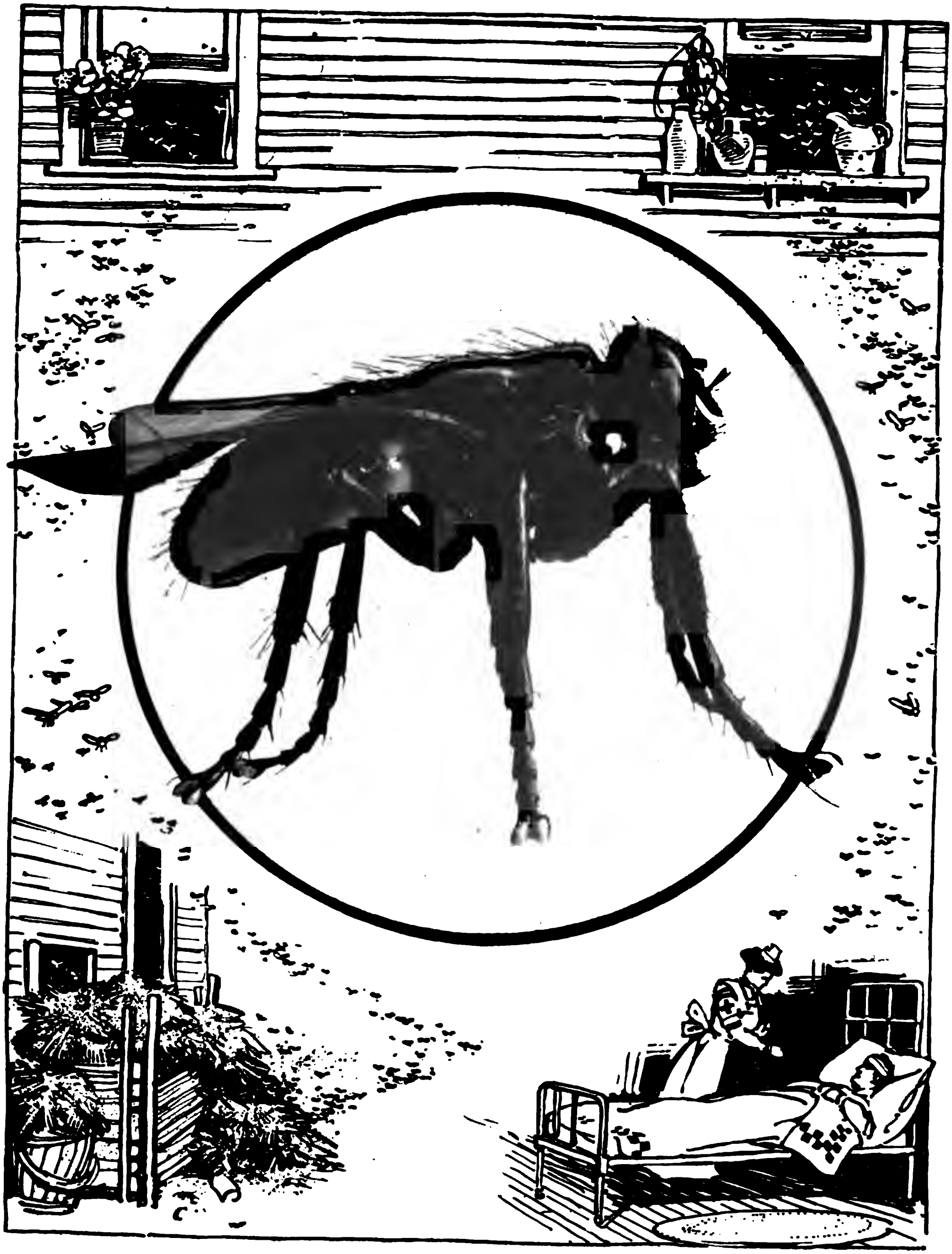

HOW THE FLY SPREADS SICKNESS.
Evolving from a maggot, it enters our homes, poisons our food, and sends us to the hospital with typhoid fever or other disease.

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THE TECHNICAL WORLD MAGAZINE

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POISONER A TABLE GUEST

By ROBERT FRANKLIN

It is quite probable that many people will read the statements in the following article with horror. That such may be the case is the honest hope of author and editor. We, the enlightened home-makers of this land, look well to the plumbing of our houses, we have meat and milk inspectors, we pass and enforce pure food laws, we filter and boil our drinking water, we use antiseptics and disinfectants right and left; yet we are positively harboring, in criminal ignorance and carelessness, one of the most dangerous foes of human life and health that exists. Read and learn and tell your neighbor that the common house-fly, which has been looked upon only as a buzzing nuisance, is more dangerous than any mad dog that ever roamed at large, than any poisonous reptile, than any bad drain; and then do something in your own neighborhood to help forward the national movement to crush him out of existence.

IT happens every day, and so one pays very little attention. May be it is the butter, or perhaps the slice of bread alongside one's plate. Or else, quite possibly, it is the milk in the pitcher. But, whatever it is that attracts the omnipresent fly, its appearance, as it crawls over the food on the table, is unappetizing.

This sort of thing seems to be unavoidable—wherefore the person who deems himself philosophical puts up with it patiently. Flies are an annoyance of course; they are even a nuisance—but, aside from the obvious precaution of window-screens, what is one to do? They are a kind of continuous plague that has always afflicted mankind, and presumably will afflict him in the future.

Here, expressed in a few words, is a pretty fair statement of the attitude of the people at large in regard to house-flies. It represents a combination of ignorance with an indifference springing from long habit. But, before going further, let us consider the facts about the above-mentioned fly, which, having tasted the butter and sampled the bread, is now by way of drowning himself in the milk-pitcher.

Is the insect a desirable table guest? Well, hardly. Annoying? Yes, of course. But this is a trifling matter, relatively speaking. It is not only likely, but altogether certain that the fly in question has recently been walking over some sort of unspeakable nastiness, and that his feet in particular are covered with putrefactive and other objectionable germs—which, as a matter of course, are freely transferred to the butter, the bread, or any other food over which the insect crawls.

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Unfortunately, a fondness for human food and drink is not the only weakness of the house-fly. Filth of all kinds has for him an irresistible attraction; and it is this commingling of tastes that renders him so dangerous. Above all things, he seems to delight in feeding upon the waste products of the human body, and in this way it is that he exercises so important a function as a carrier of typhoid fever.

The health authorities of New York City estimate that about one-half of the deaths from typhoid in the metropolis annually are attributable to the distribution of the germs by flies. But, serious as this matter is, it is of vastly less importance than the destruction of human life, particularly that of young children, by the bowel complaints which these insects are chiefly instrumental in spreading. It is reckoned that deaths from these latter maladies in New York would be reduced from 7,000 to about 2,000 a year if proper precautions were taken to prevent the breeding of flies.

In view of these facts, and of others presently to be recited, it is not surprising that some communities, notably Washington, should have begun crusades against the fly pest. People in many parts of the country are beginning to wake up to the fact that the insect is not merely a nuisance, but a menace to health and life. Health boards in various cities are taking action; some of the state boards of health are doing likewise; and the Federal authorities are coöperating by every means in their power—the great object in view being to arouse public sentiment on the subject by making the facts widely known.

Dr. L. O. Howard.
The government entomologist-in-chief, who is leading the crusade against the house-fly.

Publicity is what is principally wanted. It is a question of educating the people on the subject — of making clear to them the mischief done by house-flies, and the ease with which the pest can be done away with by the adoption of a few simple precautions. Only the other day a large poster-sheet was issued by the state board of health of Florida, intended for wide distribution and to be tacked up in all public places — the printed information on it being rendered more impressive by a vividly-drawn series of pictures showing flies winging their way directly from garbage cans, heaps of filth, and other sources of pollution, to the food on the dinner-table, the baby's milk, and the bedside of the typhoid fever patient.

It is, in short, an anti-pollution crusade that has been begun. The people must be made to realize that the house-fly is, of all existing creatures, the most dangerous to mankind. While—owing to the cause above mentioned—it makes a specialty of intestinal diseases, it is also a carrier of tuberculosis. Tubercular material, like any other nastiness,

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attracts the insect, and for this reason should be carefully protected from flies. Otherwise, they will carry the germs to the kitchen and the table, depositing them upon food.

To protect all kinds of foodstuffs from flies is now realized to be of utmost importance. Indeed, the ominous buzzing so frequently heard in the pantry is far more to be dreaded than the high-keyed note of the mosquito in the sleeping-room above. For there is no such thing as a clean house-fly; the insect, bred in filth, is always a carrier of microbes. Microscopic examinations made by the health authorities of New York City, in 1907, showed that the average fly among 414 of the insects caught between July 27 and August 20, the height of fly time, carried on its body 1,222,570 bacteria.

These experiments indicated that the number of bacteria on a single fly may range all the way from 550 to 6,660,000. As summer advances, the number of germs per insect rapidly increases. The method adopted was to catch the individual fly with a sterile fly-net, introduce it into a sterilized bottle of water, and shake the bottle to wash the germs from its body—the result being just about what would happen if the fly had fallen into a jug of milk. Some of the flies were captured in cow-stables, pig-pens and swill-barrels. It is from such favorite haunts that they come direct to our kitchens and dinner-tables.

BACTERIA LEFT BY FLY PASSING OVER GELATINE PLATE.

So conspicuous is the house-fly as an agent for the distribution of typhoid fever that the government bureau of entomology suggests the appropriateness of calling it the "typhoid fly." Beyond question it was mainly accountable for the outbreaks of this deadly disease in our military camps during the war with Spain, in 1898. Every regiment developed typhoid within eight weeks after assembling in the encampments, and in every one of the camps, in the North as well as in the South, the malady became epidemic.

From first to last, one in every five of our soldiers in the national encampments developed the disease, and of the total deaths more than eighty per cent were caused by typhoid. It was the flies that did it. Indeed, they were seen walking over the food in the kitchen tents and mess tents with their feet visibly whitened by lime from the camp latrines. Every man sick with typhoid became a fresh source, through the medium of the insects, of infection for his comrades. In autumn, as the weather grew cooler, the flies gradually disappeared, of course, and the disease diminished proportionately with the death of the pernicious pests.

Thus was furnished a very striking object lesson in the relation between the house-fly and typhoid fever. But there is plenty of other evidence. Physicians hitherto have been accustomed to regard

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as inevitable what they call the "fall rise" in typhoid deaths—that is to say, the marked increase in the number of such deaths in the autumn of each year. But it is noticeable that if the time be set back two months, from the report of death to the contraction of the disease, it exactly corresponds to the period when flies are most numerous and active. In other words, the flies do the mischief, and about sixty days later the victims perish.

The diarrhoea, summer dysentery, and other intestinal complaints which carry off so many young children in hot weather have always been attributed mainly to temperature. But it is now realized that this was a mistake. The diseases in question are so prevalent at that time of the year because it is then that flies are most numerous. They are caused by specific and well-recognized germs, which the flies distribute. Hence —as is now for the first time understood—the relative immunity of breast-fed babies to such complaints, as compared with infants artificially fed, whose food is more or less exposed to the dangerous insect.

It would be incorrect to suppose that flies are alone responsible for the distribution of typhoid fever. There are other sources of infection, notably water and milk. But the insect is certainly one of the principal agents concerned; and as for dysentery and other such intestinal disorders, it is undoubtedly the chief mischief-maker. In New York City several local epidemics of typhoid have been traced to flies; and figures of deaths and of fly multiplication, reduced to mathematical curves, have shown that these infectious bowel complaints, which cause so great an annual slaughter of young children, increase and diminish exactly with the augmentation and falling off of the number of flies.

In order to make the experiment as fair as possible, the flies wanted for bacteriological examination were caught in cages in various parts of New York —on the water front, in the slum districts, on Fifth Avenue uptown, and elsewhere. One was captured on South Street, which on inspection was found to be carrying in his mouth and on his legs over 100,000 fecal microbes. He had been walking over filth on the water-front, and was on his way to the nearest milk-pitcher. Similar studies, by the way, were made last summer in the city of Washington, including "intensive" observations of both flies and diseases in a district comprising eight squares. The results are not yet quite ready for publication.

One of the diseases spread by the house-fly is Asiatic cholera—a fact discovered as long ago as 1849, when there was an epidemic of that dreaded malady at Malta. A warship of the British Mediterranean Squadron, the *Superb,* was cruising for six months during that period, with cholera on board most of the time. On leaving Malta and putting to sea, the flies which had swarmed on the vessel gradually disappeared, and the scourge slowly left her. But later on, when she entered the harbor of Malta again, though without communicating with the shore, the flies returned in force, and the cholera likewise. Since that date cholera germs have been found repeatedly in fly-specks in cholera wards in hospitals.

Dr. George M. Kober, of Washington, a recognized authority, says that, allowing for time lost by sickness, expense for medical treatment, etc., typhoid alone, for which the fly is so largely responsible, costs the people of the United States $350,000,000 annually.

Notwithstanding these facts, the insect is encouraged to breed unrestricted everywhere. It is allowed to enter freely the houses of most of our people. It is permitted to spread germs over food supplies in our markets, in our kitchens, and in our dining-rooms; while in public restaurants the patron is compelled literally to fight for his meal with swarms of the parasitic creatures, alert, persistent, and unterrified.

Why endure it? If it were difficult to get rid of the house-fly, a general failure on the part of communities to make any effort to reduce its numbers might properly be termed criminal neglect. But, inasmuch as it is an easy matter to put a stop to the plague for good and all, there is no excuse. That it continues to exist is attributable to a combination of ignorance and carelessness which is a disgrace to our civilization. Flies sig-

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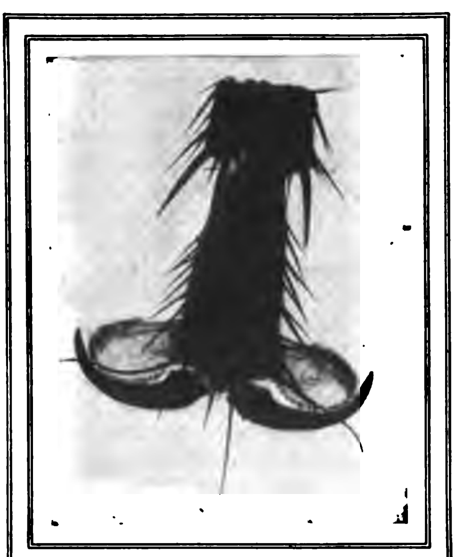
nify public and widespread pollution. They signify not merely discomfort, but the wholesale distribution of disease and death. Is it not full time, then, that the people should rise up and exterminate the cause of such mischiefs?

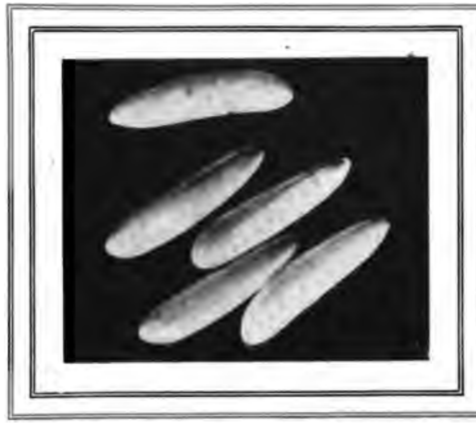
In order to make clear the easy means whereby the house-fly may be exterminated, it is first necessary to explain in a few words its method of reproduction. The female always lays her eggs in accumulations of filth of some kind—whence it follows that, if filth were not allowed to accumulate, there would be no more flies. But the particular kind of filth most sought for the purpose is horse manure. It is reckoned that ninety-five per cent of all the flies in our cities are propagated in stables where horses are kept. Every such stable is a fly hatchery; and a single stable will turn out enough flies continuously during the summer to supply an entire neighborhood.

The female lays her eggs in a closely-packed clump either in or upon the manure or other filth material. Usually she deposits about 120 of them in a batch. They are of an elongated almond



Foot of a House-Fly. Greatly Magnified.

shape, pearly white and highly polished. With the microscope they are seen to be finely sculptured with delicate hexagonal markings. Under favorable circumstances they will hatch in ten or twelve



Eggs of House-Fly.
Greatly enlarged.

hours. It is possible that a female fly may lay more than one batch of eggs during her life, but this is a question not yet satisfactorily settled.

From each egg is hatched a footless maggot, which feeds upon the decomposing vegetable matter to be found in the manure or other material by which it is surrounded. In stable manure the eggs may often be dug out in masses numbering many thousands, from a few inches below the surface. At the end of a week or less the maggots are transformed into chrysalids, which, at first of a pale yellowish color, rapidly change to bright red and finally to a dark chestnut hue. Another week, or less, passes by, and then the perfect flies break their way out of the chrysalids and take wing. They pair promptly; the females lay fresh batches of eggs, and another generation is started. The whole cycle, from egg to perfect insect, under favorable circumstances, is accomplished in from ten days to a fortnight.

The insects will breed in fermenting vegetable or animal material of almost any kind. Garbage suits them first-rate. The maggots and chrysalids have been found in great numbers in rotten straw mattresses, among old cotton garments, and even in waste paper that had been

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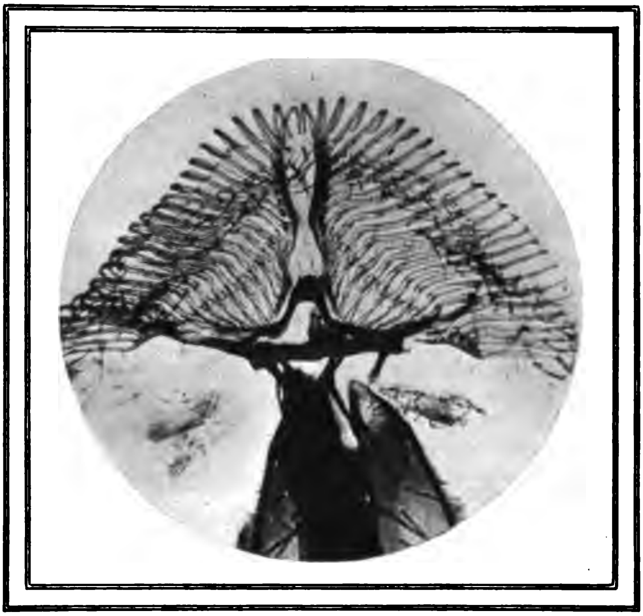
exposed to wet. But the fly crop is derived mainly from the source already mentioned.

Now, so far as stables are concerned, which are accountable for ninety-five per cent of the fly output in cities, the hatching of the insects can be absolutely prevented by the simple device of putting all manure into a covered receptacle, and removing the contents once a week. This receptacle should be a water-tight bin or pit, provided with a cover, so as to prevent the ingress and egress of flies.



TONGUE OF A FLY, MUCH ENLARGED.

The additional methods demanded are the following: Abolish all unsanitary outhouses. Allow no accumulations of filth of any kind. Compel people to put all their garbage in covered cans, and remove the contents at least once a week. Compel owners of abattoirs to keep all refuse in covered receptacles; and remove such waste at least once a week.

If these simple measures were enforced in any community, the house-fly would soon become a rare species of insect in that locality. All that is needed in order to achieve this end is an adequate system of inspection, especially with regard to stables, and the enforcement of a suitable penalty in cases of failure to obey the ordinance. Nobody could seriously object, inasmuch as not much trouble and no expense worth mentioning would be involved.

As Dr. L. O. Howard, the government entomologist-in-chief, says: "It is the duty of every individual to guard against flies on his premises. It is the duty of every community, through its board of health, to spend money in warfare against this enemy of mankind. The duty is as clear as if the community were attacked by bands of ravenous wolves. That the typhoid fly—a creature born in filth, and literally swarming with disease germs—should practically be invited to multiply unchecked, even in great centers of population, is nothing less than criminal."

The health authorities of New York City estimate that the anti-fly work, when properly carried out, will reduce the typhoid deaths in the metropolis from 650 to about 360 a year, and diarrhœal deaths from 7,000 to about 2,000. This saving of more than 5,000 lives per annum will be accompanied by an additional saving of 50,000 cases of serious sickness.

An objectionable characteristic of the house-fly which has not been mentioned is that it is strongly attracted by any moist sore on the body of a human being or animal. During the civil war there was an appalling mortality on both sides from what was called "hospital gangrene"—a malady now known to owe its distribution mainly to flies. Unfortunately, the germ theory of disease was as yet undeveloped, and medical science knew no means of fighting the dreaded complaint. Nothing is easier than for a fly to alight upon an erysipelas sore, and carry germs from it to a

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healthy wound on another person—the usual result in such a case being the development of "traumatic erysipelas," which is an extremely dangerous and frequently fatal disorder.

One fact that ought to be very distinctly understood is that the filth carried by a fly on his legs, though quite sufficient to do plenty of mischief, is inconsiderable in quantity compared with what he conveys from place to place in his intestinal canal, depositing it wherever he happens to alight. So constant is this process of deposition that, as ascertained by careful observation, five minutes rarely elapse without the making, by any individual fly, of at least one fly-speck. If people realized that this was continually going on while flies crawled over their food, they might better appreciate the importance of preventing it.

A painstaking study of the subject by Dr. N. A. Cobb, of the Department of Agriculture, has shown that the number of germs of all kinds passed in this way through the body of the fly, and deposited by preference on our walls, picture-frames, chandeliers, furniture, and, worst of all, food-stuffs, exceeds by at least 1,000 times the number carried on the legs. This fact has been ascertained by actual count. Furthermore, by a curious paradox, the house-fly is, after its own fashion, very cleanly. It is constantly engaged in washing itself, and the filth on its legs it cleans off, as anybody may easily notice, if he will but watch the process, by drawing them through its mouth, thus transferring the virulent germs to its stomach.

Typhoid fever, dysentery, cholera morbus, tuberculosis, Asiatic cholera, and certain infectious eye diseases are among the maladies already known to be distributed by the house-fly. But in all likelihood it carries the germs of a good many other complaints. By occupation a parasite on man, living at his expense, and depending upon him to a great extent for protection, this abominable insect returns the obligation by afflicting upon its benefactor suffering and death in a great variety of forms.

It is a remarkably intelligent insect. From birth it seems to be perfectly well aware that man is its enemy, but apparently regards him with contempt as a sluggish and crawling creature of inferior activity and resource. Its sight is very acute, each of its two huge eyes being literally several thousand eyes in one; and for each of these myriad eyes it is provided with a separate lens and

The Under Side of a Fly, Magnified.
A remarkable photograph, showing intimate details of his anatomy. This is not the house-fly, but a nearly related species.

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retina—though, of course, all of them furnish to the brain of the fly a single image, just as our own two eyes see only one object. In addition, it is able to think and act upon its thought in a small fraction of the time which the smartest man requires to go through the same processes.

The fly's cunning is doubtless a matter of inherited experience. Unlike ourselves, the insect is born wise. It sees not very much of the world during its lifetime, for it rarely travels more than a few rods away from the place where it was originally hatched. The widespread popular notion that it bites on occasions is wholly erroneous. It has no mouth-parts for biting. Occasionally stable flies, of entirely different species, find their way into dwelling-houses and bite people—whence the mistake. Another wrong idea is that it walks on the ceiling by the help of sucking discs attached to its feet—the fact being that each of its six paws is provided with a pair of cushions and two hooks. The cushions are covered with minute hairs, which are kept moist by a secretion, causing them to adhere to a smooth surface.

Like other insects, the house-fly has enemies, one of which is the familiar household myriapod, commonly known as a "centipede." But the most effective foe of the fly is a peculiar fungus disease. One sometimes sees a specimen of *Musca domestica* fastened to a window-pane by the whitish threads of this fatal fungus. But, in spite of all hostile influences—even cold, which wipes out the great majority in the winter time—a sufficient number of flies, in cool latitudes, always find shelter, mostly in dwelling-houses, to start a fresh generation in the following spring.

It does seem wonderful, when one comes to think of it, that so small and contemptible an insect should be able to do such an immense deal of harm to mankind. But it is much more astonishing that we, now that we have come to understand the dangerous character of this hitherto-despised adversary, should not only permit, but encourage it to breed among us—actually, as it might be said, establishing and maintaining hatcheries, in the shape of stables, for its artificial propagation. Surely, however, this state of affairs cannot much longer continue. Ignorance no longer furnishes an excuse. Action must be taken for the extermination of this insect enemy. In fact, it has already been begun. And there is every reason to believe that eventually the adoption of proper measures, such as those above suggested, will result in the practical extirpation of the winged peril in our communities and free us from some of the ills that beset us.

A Toast

Here's to the maiden of bashful fifteen;
Here's to the widow of fifty;
Here's to the flaunting extravagant quean,
And here's to the housewife that's thrifty!
Let the toast pass;
Drink to the lass;
I'll warrant she'll prove an excuse for the glass.

—SHERIDAN

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NEW GOOD THINGS FOR AMERICANS TO EAT

By René Bache

TWO new vegetables for the kitchen garden, a giant radish and a cabbage from Brobdignag, have recently been introduced into this country by our agricultural explorers. They are remarkable not only for size, but for excellence of flavor, and will be heartily welcomed as palatable additions to the American bill-of-fare.

The radish in question comes from Japan, where it is known as "sakura-jima." It attains a length of two feet or more, and sometimes a circumference equal to that of a man's thigh. Although the seed is not planted until the middle of the summer, the vegetable grows with wonderful rapidity, and early in autumn is ready for the table.

Being so remarkably big, one might imagine that this giant radish must be coarse of texture and crude of flavor, but the very opposite is the fact. Its substance is very tender, and it is sweeter and more agreeable to the taste than the radishes with which we are familiar. One advantage of it is that, starting late in the season, it can be planted after other garden crops are gathered and out of the way—even as late, indeed, as August.

The government plant bureau recommends this vegetable in the highest terms. It ought before long to be in every kitchen garden; and there is no reason why it should not be widely planted, inasmuch as the seeds are already to be obtained from some seedsmen. The huge radish will keep all winter in a cool cellar. It may be cooked like turnips and beets, or cut into little squares or strips, and served just as we ordinarily are accustomed to serve common radishes.

As for the giant cabbage, it comes from China, and is quite as remarkable in its way as the radish. It attains a weight of forty pounds, and possesses so fine a flavor that cabbages of the kinds to which we are accustomed must be regarded as poor things, relatively speaking. This remarkable vegetable from the Flowery Land has a much more delicate taste than ordinary cabbage, with less of the crude "cabbagy" intensity, which many folks find objectionable.

Another novelty, likewise from China, is a giant persimmon. It represents an entirely new type of the fruit. Four inches in diameter, it is not only seedless, but puckerless, so to speak. One of its peculiarities is a groove that encircles it horizontally. But the absence of the pucker is most important. One can eat it before it is soft—which is not the case with the persimmons already familiar to us in this country. Hence it is practicable to ship it to market while it is still hard—a most vital point commercially, of course. Already the scions have been distributed among growers in several of the Southern States, for experimental culture; but this persimmon is so hardy that efforts will be made to produce it as far north as New York and New Jersey.

From this same country has recently arrived a new fruit called a "date," but which is in reality not a date at all. It does not even grow on a palm, but on a thorny kind of tree, by grafting. Some of its varieties are seedless. It has a very delicious flavor, and in the Orient is usually dried for market—one method of preparing it being somewhat like that applied to so-called "glacés fruits." One

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NEW SPECIES OF ORNAMENTAL FIR FROM CHINA.

great advantage of it is that it requires very little water, so that it is likely—grown in orchards, as in China—to prove exceptionally valuable in Arizona and New Mexico.

Meanwhile the plant bureau has become exceedingly interested in the development of bamboo possibilities in the United States. A very large shipment, comprising 3,000 bamboo plants of choice and selected varieties, was recently received from Japan at Chico, Cal., where the government maintains extensive experimental gardens. There the plants have already been set out—with an aim in view which is of much importance, and which will presently be explained.

Broom-Corn Millet.
A new grain from the Steppes of Siberia.

It is the intention of the bureau to establish, at three places in different parts of the South, trial groves, as they might be called, of choice bamboos. Necessarily, they will take a number of years to develop. There is no reason to doubt that they will succeed, however; for in the same regions are already many clumps of bamboos owned by private individuals, which have thrived. The localities chosen for the groves will be selected with reference to the fact that such bamboo clumps are growing in those neighborhoods.

When the groves in question have had time to become mature, manufacturers in various lines, who might utilize bamboo for one pur-

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GIANT CHINESE "PUCKERLESS" PERSIMMONS.
This fruit, prepared like figs, is a delicious addition to our market variety.

EDIBLE BAMBOO SHOOTS.
The large one weighs sixteen pounds, but the smaller ones held by boy at right are of a choicer variety.

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pose or another, will be invited to view them, and to consider whether they would care to attempt experiments in utilizing the material. If so, they will be supplied with all the bamboo they require for the test. This cannot be done, of course, with a mere clump or two of bamboo, inasmuch as the quantity available would be too small to afford opportunity for an industrial experiment.

HUNTING NEW GOOD THINGS TO EAT.
Dr. Frank N. Meyer, government agricultural explorer, in Northern China.

On the other hand, when several groves, each of them comprising a number of acres, are mature, experiments in the utilization of bamboos in all sorts of ways can be undertaken on a practical and satisfactory basis. It is felt that the government ought to carry the matter up to this point, where capital will presumably be found to take it up. In the meantime, at Chico, the bamboos will be propagated as rapidly as possible, in order that, when the experiments shall have proved successful, the government may be in a position to supply the plants in such quantities as may be desired.

As is well known, the bamboo is one of the most useful plants on the face of

BASKETS OF BAMBOO.

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the earth. It is also very ornamental—so much so, indeed, that any well-to-do American citizen would be glad to have a clump on his estate. A grove of timber bamboos is one of the most beautiful sights in the world. The ground beneath is covered with a dense mat of light-brown leaves, upon which glimpses of sunshine fall through the feathery foliage far overhead. The stems—dark green in color and perfectly symmetrical—are leafless and branchless up to a height of twenty feet or so. But here and there are springing up young shoots—so tender that, when they are higher than one's head, one may break them off with a slight blow of the hand; yet which grow so fast that in thirty days they are twenty-five or thirty feet tall.

The material they furnish is altogether different from any wood that we know. It does not have to be seasoned, but may be worked green. In Japan it is commonly used for barrel-hoops, shrinking as it loses its greenness, and holding with a firm grip. Extremely flexible, and somewhat resembling hickory in this respect, it is so straight in the grain that it can be split into the finest and most beautiful ribbons, out of which baskets of all kinds are woven. Ladders are made of it; likewise trays, screens, chicken coops, pots for plants, irrigating pipes, and a multitude of other useful things.

From the Chinese province of Manchuria has recently been obtained a "grain sorghum" that promises to be very valuable. In that part of the world it is utilized as a cereal for human consumption; and already farmers in our own country are using similar varieties in a small way for making griddle cakes. The plant produces huge ears, weighing three or four ounces apiece and literally loaded with large grains.

It is worth mentioning incidentally that a very superior broom-corn millet, recently obtained from the steppes of Siberia, is likewise used for human food in the region whence it comes. Like the above-mentioned "grain sorghum," it produces a very large yield. But both of these have been introduced into this country primarily to feed cattle and horses.

The above mentioned are only a few of the new and valuable plants recently introduced into this country by our agricultural explorers. Among these one of the most important is a species of plum, called ***prunus davidiana,*** which

TWELVE DAY OLD SHOOT.
The remarkable growth of bamboo is here shown.

in China is almost universally used as a "stock" on which to graft peaches, apricots, cherries, plums, and almonds. As everybody knows, such fruits are never grown on their own roots, but always by grafting or budding them upon a suitable stock.

Inasmuch as the stock becomes the groundwork, or foundation, of the grafted plant, so to speak, it must be chosen with utmost care. That it shall

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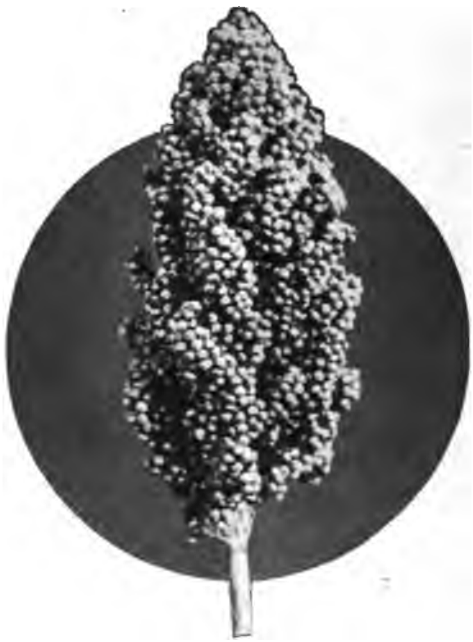
be vigorous is a prime and obvious requisite. On the other hand, if too vigorous, it will outgrow and throw off the scion. There are other essentials, of course; but it will suffice here to say that the enormously profitable plum-growing industry of California depends fundamentally upon the use of an exactly suitable stock, while two well-known stocks are the basis of the success of the great cherry orchards of New York State.



GRAIN SORGHUM FROM MANCHURIA.
The heads weigh three or four ounces apiece.

Such being the case, it is strange that the stock utilized so universally in China for grafting cherries, apricots, almonds, plums, and peaches, should never have been brought to this country until a few months ago, when it was introduced into the United States by Dr. Frank N. Meyer, one of the ablest and most enterprising of the government explorers, who has secured in the Orient many plants of value. The ***prunus davidiana*** is being

THESE ARE RADISHES.
Giants of their kind, as large as a child's head.

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grown from seed by the plant bureau, and eventually experiments will be made by grafting the above mentioned fruits upon it as a stock. Four or five years will doubtless be required to find out just how satisfactory it is for the purpose, but excellent expectations are entertained.

All of these fruits, it will be understood, are of the same family; and, if it were desired, all of them could be grown on a single tree—just as Mr. Burbank has grown—by grafting—twenty or thirty different kinds of apples on one tree. But, of course, this is mere freak business, and of no horticultural importance whatever. What really is important is the possibility that the introduction of the new stock from China may beneficially affect the orchard industries concerned.

The variety of vegetables, and animals, too, available for the use of man as food, is constantly increasing. Burbank has bewildered us by showing us the well-nigh infinite possibilities in the way of fruit cultivation. Future generations will look back upon the present generation, as we look upon past generations, with pity that their palates did not know the joys of sweet new fruits or other variations in the edible vegetable kingdom.

It seems only the other day that the French alone ate frogs' legs, mushrooms, and tomatoes—"love apples" as the last were called in England and America, grown like flowers for purposes of ornamentation, but thought to be poisonous, and hence scrupulously avoided as a food.

A New Kind of Peony from Central China.

But when we discover that bamboo shoots, young, tender, and green, are also quite palatable, and that the species may be used as a most welcome article of diet, our wonder grows more and more.

'Tis Sweet to Think

'Tis sweet to think that where'er we rove
We are sure to find something blissful and dear;
And that when we're far from the lips we love,
We've but to make love to the lips we are near.

—Moore.

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THE DEADLY TOY PISTOL

By C. H. Claudy and Clarence Maris M.D.

As a tribute to the signing of the Declaration of Independence, each Fourth of July we sacrifice about four hundred lives. Toy pistols, producing lock-jaw, **account for seven-eighths of these deaths.**

GLORIOUS Independence Day is coming. It is about time for the fond parent to get ready to take his small son out on a vacant lot, stand him up conspicuously in a corner and see how many times he can hit him with a revolver at fifty paces. If, after ten shots, the boy is only hit once or twice and still retains some remnants of life, the fond parent may take what is left of his son back home and be thankful that Nature made him a poor marksman.

What? I am talking nonsense? Well, as between taking my son out and shooting at him and giving him a toy pistol and cannon crackers and letting him shoot himself with the germs of lockjaw, I can see little choice.

Listen, you who think that, because you used a toy pistol harmlessly and escaped, your boy must needs be immune. Did you know that since the introduction of the toy pistol and giant cracker the number of lives sacrificed *yearly* in the celebration of the Fourth of July has averaged about four hundred, the greatest mortality being from fireworks used on the Fourth in 1903, when the number tabulated by the Journal of the American Medical Association was four hundred and sixty-six, of which three hundred and sixty-three were from tetanus caused by toy pistols?

Three hundred and sixty-three lives—almost one for every day in the year—is the frightful accounting of one day in one year; and the account is to be credited to harmless enthusiasm, a mistaken patriotism, thoroughly mixed with ignorance and the application to wounds of "remedies" which did a thousand times more harm than good.

Do you know what lockjaw is? Do you know what it looks like? Can you stand a few paragraphs of description? I warn you, matter of fact as I shall make them, they are not pretty words, especially if you visualize your own son as so suffering.

When lockjaw, or tetanus, is about to develop, the wound from which the infection has come and which has probably been healing gets irritable, red and tender, and pains shoot up the nerves toward the spine. The first evidence of the seizure is nearly always in the nerves which control the muscles in grinding food and the jaws become rigidly closed; hence the name given to the disease. The muscles of the throat become so sensitive that they resist the passing of food, making it painful and difficult to swallow. The muscles of the face take a fixed position, with lips retracted exposing the teeth; the brow is wrinkled and the eyes stare, giving the

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countenance a mixed expression of anguish and laughter, producing the "sardonic" expression peculiar to tetanus. The rigidity of the muscles next extends to the body and its extremities and the victim becomes helpless, stiffened. Often the muscles of the back are drawn so tense that the body is bent like a bow, resting on the head and heels. Less frequently it is bent forward or to one side. In the beginning of the attack the rigidity is not constant and does not affect all the groups of muscles equally, and may pass from one to another group with intervals of complete relaxation.

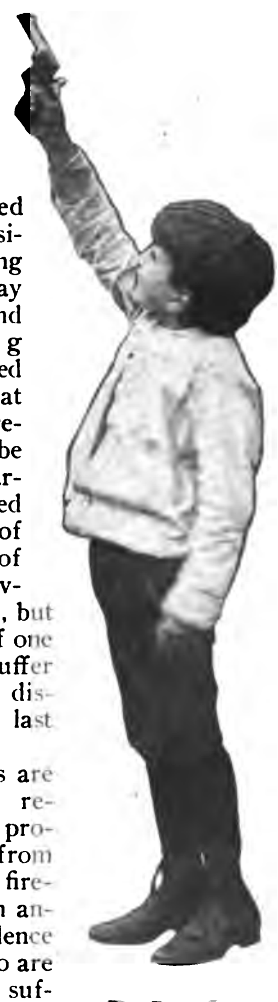
But the spasms become more frequent and severe and are presently excited by the slightest muscular effort. So exquisitely excitable are the nerves that a mere touch, a current of air, the reflection of light from any bright object, will bring on a sudden spasm in all the muscles ordinarily controlled by the will; the face is horribly distorted, the spine bent, and the hands violently clinched and drawn up. So severe is the contraction that muscles are sometimes torn in two. During the convulsion there is a severe pain through the stomach and back. Immediately following the maximum of the paroxysm, the breathing becomes easier and a little fluid may be taken through a tube.

Unfortunately the mind of the sufferer is clear and his senses acute during the attacks. Profuse sweats occur, and the voice is dry, gutteral and, at times, unintelligible. Owing to the severe activity of the muscles, lockjaw causes the highest fever ever seen, and the body temperature sometimes rises for an hour or two after death. Finally the boy, *your boy,* sinks from exhaustion or a severe paroxysm arrests the breathing and death terminates a disease which has the worst terrors of meningitis, strychnine poisoning and hydrophobia, causing an agony hardly to be surpassed by the tortures of a martyrdom, and a distress to the helpless bystander which is unmeasurable in words.

The enormous death rate from tetanus on the Glorious Fourth has been reduced by publicity. Newspapers and magazines published the facts in the case and much good was done, many lives saved. Parents learned that a wound from a toy pistol, however slight, should be immediately taken to the surgeon because failure to have it radically cleansed would result in lockjaw; doctors learned that ordinary disinfectants and dressings were not only futile but harmful; the authorities learned that the responsibility of controlling the danger lay upon them; and even "Young America" learned by admonition that hurts from fireworks should be referred to parents. This reduced the number of cases of Fourth of July tetanus seventy-five per cent, but still an average of one hundred youths suffer death from the disease every year; last year; *this year.*

City authorities are now facing the responsibility of protecting children from the cupidity of fireworks vendors on another Independence Day. If you, who are parents, are not sufficiently apprehensive

A Harmless Looking Toy—



But Dangerous to the User.

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to supervise the manner in which it is celebrated by your children, you must shoulder your share of the blame if things go wrong.

What causes lockjaw? The tetanus bacillus, which belongs to one of the smallest groups of micro-organisms or microbes, it having but fourteen members. They are known as "anaerobic" bacilli because they cannot feed or multiply while exposed to the oxygen of the air. If they could perform their functions and reproduce themselves in the presence of air, they would soon depopulate the earth. They are omnipresent in dust and in soils; and horse manure, which furnishes the bulk of street dust, is always alive with them. It is easy to see how liable they are to be introduced into every scratch. But, being necessarily dormant until they reach a feeding ground from which air is excluded and where animal fluids are present, they cannot poison an open wound.

When the bacillus of tetanus finds its surroundings uncongenial, it devotes its energy to the production of a spore or seed which has great power of resistance. Even if it is boiled for some time or frozen in liquid air or covered for ten hours with a five per cent solution of carbolic acid, which is as strong as can be used with safety as an antiseptic, they suffer no impairment of power to produce active bacilli. Tetanus spores kept dry on splinters of wood for ten years produced lockjaw in mice which were pricked with them.

The "rusty nail" wound, so commonly a cause of lockjaw, is dangerous, not because of the rust but because tetanus bacilli, floating in the air, have come to rest upon the nail and are carried by it beneath the skin. Upon withdrawing the nail the wound closes, thereby excluding air from the microbes deposited in it.

The bacillus of tetanus, first found in man by Rosenbach in 1886, is a slender rod which develops a spore at one end that gives it, under the microscope, the appearance of a pin or drumstick. So small is it that six could lie side by side on a razor's edge. When left deep in a wound by the instrument that made it, or when blown in with powder, these germs begin to feed upon the animal juices and to excrete the poison which is peculiar to them. Most of the microbes which are responsible for the infectious diseases, such as scarlet fever, multiply rapidly—one of them if well fed becomes a great grandmother in an hour!—and are carried in the blood to every cell in the body. The aerobic bacillus of diphtheria multiplies in a limited area, only the toxin it excretes being taken into the circulating blood. The lockjaw bacillus forms a poison which travels slowly along the nerves from their minute terminal ends at the wound to the spinal cord or brain from which they arise, so that after death there is no evidence of disease except in the nervous system.

Nearly all the cases of lockjaw reported are caused by blank cartridges, by large fulminating caps in toy pistols or by cannon crackers. The guiltless fireworks are small paper caps, torpedoes and small firecrackers. A very few deaths are from accidents with toy

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A Sane Celebration of the Fourth.
In many cities' leading playgrounds, teachers voluntarily offer their services on this day.

cannon, Roman candles, sky-rockets and such popular celebrating material.

The wound from a toy pistol usually appears trivial because there is only a small hole through the skin, produced by the entering wad, surrounded by an area that is peppered with unexploded powder grains owing to the injured part, usually the hand, being near to the muzzle of the pistol. The injury, slight in appearance, is often treated with cooling lotions or a wet rag, still worse, with salve or plaster, or worst of all, cauterized, thus sealing up the wound. It is of the utmost importance that it receive instant and intelligent surgical attention.

The wounded boy has usually been energetically engaged in getting his hands covered with street dirt in which the tetanus bacilli are ever present. They are carried deep beneath the skin beyond the reach of air which would deter them from secreting their poison when the wound is made. At the bottom of the wound is a pasteboard wad and a piece of tough skin upon which are the microscopic spores, blood and crushed flesh, an ideal feeding ground for the bacilli. These wounds are often made several inches deep, the force of the explosion having traveled along the sheaths of the leaders of the fingers or under the tough web of fascia in the palm of the hand, the destruction of tissue being very large in proportion to the size of the external opening. It is a funnel whose tip only is in sight. The lockjaw bacillus may also be carried in the powder or in dust which gets into the pistol barrel.

The technical report of a board of army officers which made extended experiments to determine if disease could be carried into an opposing army by firing disease producing bacilli out of a gun determined some interesting facts. Gun wads previously soaked in fluid containing bacilli were fired, at a considerable range, against plates covered with different foods of which the microbes are fond and the plates were then put in a temperature about that of the body. In

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Giving Water to a Tetanus Victim.
This malady is frequently accompanied by a terrific thirst. Relief can be given only between paroxysms.

every case colonies of bacteria soon developed from the seed carried on the wad. Bullets were coated and fired with the same result. Bacilli were put in the gun barrel and the bullet carried them. Finally some bacilli were mixed with the powder and when it was fired into the plates containing the microbe food at short range, unburned grains of powder carried living germs to them. Therefore the germ of this disease may come from soiled skin or in the wad, revolver barrel or powder.

To prevent lockjaw following this accident, the boy must be hurried to a surgeon, for the proper cleansing of the wound can only be done while he is fully under the influence of chloroform or ether and the subsequent dressings must be such as will permit the entrance of air.

If not removed or exposed to free air, the microbes multiply and produce their deadly poison. The number of them never becomes great and they are rarely found elsewhere than in the wound. No symptoms of tetanus are seen for a week or two because the poison, instead of being taken up by the blood current, follows along the minute cylinders of the nerves which control motion, not those which carry sensations, to the cord or brain. Snake venoms and the like produce evidence of their presence in the great nerve centers very soon because the blood carries them there directly.

Both Kitasoto in Japan and Behring in Germany have rendered animals immune to lockjaw by injecting a solution containing the bacillus diluted with an iodine preparation. The experience in the use of an antitoxin for this disease, though limited because its discovery is recent, has been very satisfactory. Some

Opening a Powder Wound Isn't Much Fun, But It's Better Than Lock-Jaw.

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day tetanus, like diphtheria, will lose its terrors.

But meanwhile, what are you going to do? Are you going to give your son a chance to be another martyr to ignorance and inertia? Are you going to wait for science to put tetanus in the same class with measles? Or are you going to put your foot down and forbid dangerous fireworks? Abler pens than mine have written on the Sensible Fourth, the Truly Patriotic Fourth, the Logical Fourth. The greatest argument which can be made in favor of an Explosiveless Fourth is the toll our present celebrations take of our youngest and our best; one hundred bright young lives every year that a million people may make a noise!

The responsibility is not to be evaded. For every one of those bent and twisted bodies, those anguished faces, those clenched hands and bloodshot eyes, which implore the help and the relief from agony which you cannot give, is to be laid at the door first, of your indifference, second, your ignorance or the lack of knowledge of your doctor, third, to the greediness of vendors of fireworks and the laxness of your municipal regulations. The doctor, the vendor, the mayor, the board of aldermen—you may not be able to change the obstinacy of these.

But is there anything which prevents you from doing your share?

It seems curious, does it not? that we should let the children thus sacrifice themselves to make a Roman holiday. Mother will not let little Johnny go in swimming, mother will not let him sit around in wet clothes after he has been exposed in a rain storm, mother will not let him have a real gun, but she will let him play with a weapon, one of the most terrible and dangerous ever devised by man, despite its harmless appearance.

TOO MUCH NOISY PATRIOTISM FOR THIS LITTLE CITIZEN.
He had a bad head wound from exploded powder.

It is the apparently insignificant things that are oftenest the most dangerous. We all have read or heard the story of the king who lost horse, self, battle, and kingdom, because he neglected to have a nail in his horse's shoe replaced. It is the apparently insignificant wound made by a bit of powder that throws the Fourth of July victim into the terrible spasms that drive father and mother wild with mental anguish and despair, before death happily releases the little sufferer from his terrible agony. If the wound were properly treated at once, there would be no need of the desperate struggle against the tetanus bacilli, which, however hard or faithful the battle may

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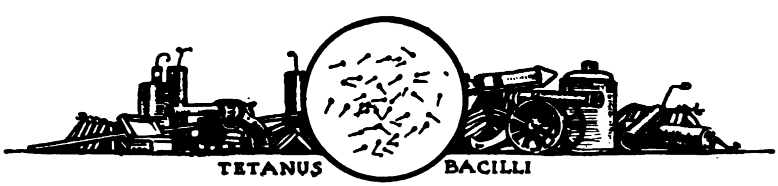
TWO WEEKS IN BED AFTER THE "GLORIOUS FOURTH."
Thanks to modern method of keeping wounds open and disinfected. no tetanus resulted.

be waged, must inevitably result in the death of the victim, once the terrible germs have begun to poison the blood.

There are three ways of combating tetanus: properly treating wounds, prohibiting the sale of toy pistols, etc.,—which doesn't always prohibit—and, best of all, seeing to it personally that your children employ only harmless noise-makers.



Melodies Unheard

Heard melodies are sweet, but those unheard
Are sweeter; therefore, ye soft pipes, play on,—
Not to the sensual ear, but, more endear'd,
Pipe to the spirit ditties of no tone.

—KEATS.

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A MYSTERY AMONG RAILROADS

By WILLIAM THORNTON PROSSER

PICTURE the two foremost railway magnates of the country—James J. Hill and E. H. Harriman — contesting in one of the greatest transportation battles of the time for the control of the Northwest, each one blocking the other's progress at every step, each one ready to jump at the other's throat, and suspecting the other of every dire design that the moral or the statutory law might prohibit. Would you imagine it possible for a third railway man, unknown and unheralded, to step in between those two warring giants and build a road on their battleground, spending millions and millions, without disclosing the parentage of his money-bags, resisting every inquiry and baffling all the detectives upon his trail, for three years?

This feat of mystifying the transportation interests of the entire West as well as of Wall Street has been performed so successfully by Robert E. Strahorn that to this day no one knows more about his North Coast Railway, with his seven hundred miles of projected railway and eighty miles of completed roadbed, than when he first sent his surveyors into the field. This North Coast Railway is indeed the enigma of the Northwestern railway situation. It is the riddle of riddles. Time and again have his rivals thought to pry from President Strahorn his secret in the courts, or surprise it from him while he slumbered. They might as well have whispered to the winds or asked information of Egypt's stony Sphinx.

ROBERT E. STRAHORN.
President of the North Coast Railway.

Time was when Strahorn and his mysterious enterprise were looked upon with contempt. "Who is Strahorn?" railway men sneeringly inquired when his plans were brought to their attention. "Evidently he doesn't amount to much; nobody ever heard of him." But now the Northern Pacific and Great Northern are fighting with all their might and main to keep this same man out of Spokane, where he has purchased the finest terminal grounds possessed by any of the railways entering the eastern Washington city. His rivals do not sneer now when they speak of the mysterious North Coast or its secret-keeping executive.

The mere fact that some man is building a railroad out West somewhere is of no particular significance. To understand why so much stress is placed upon the operations of the North Coast one must know something of the railway situation in its sphere of operation. For the last five years transportation interests have been struggling for this Northwestern field, with its rich timber, its agriculture, its trade with the Orient, its gateway to Alaska and the Canadian north, its great coastwise traffic.

A quarter of a century ago Henry Villard completed the Northern Pacific to Puget Sound—with bankruptcy as his reward, in spite of land grants from

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CANAL MOVED TO MAKE ROOM FOR RAILROAD TRACKS.
Fifteen miles of the Kiona Canal were purchased for this purpose.

Congress which would make an ordinary state or two. In the early nineties Mr. Hill extended his Great Northern line to the coast, paying its way as he went. Then the Great Northern's president gained control of the Northern Pacific; then of the Chicago, Burlington & Quincy, and operating Burlington trains through to the coast.

This was too good a thing for Mr. Hill; Mr. Harriman and the other railway captains viewed Mr. Hill's supremacy with alarm. When Hill began to build a line down the north bank of the Columbia River, from Spokane to Portland, that started things in earnest. Harriman tried to block him, and claimed an old right-of-way, but Hill won out. Then Harriman rushed over to Seattle and Tacoma, and spent some fifteen millions of dollars or more buying terminal sites, rights-of-way and shore lands for docks. He announced plans for the building of the Union Pacific north from Portland, even as far as the Canadian line.

Then the Chicago, Milwaukee & St. Paul, with the Rockefeller interests behind it, decided to take a hand in the Northwest fight, and began work on its Puget Sound extension, something like 1,200 miles west of its South Dakota branch. The last spike was driven the latter part of March of this year. In the height of the railway excitement, one Robert E. Strahorn rose up with the announcement that the North Coast Railway would be built from Spokane across the state of Washington, with many branch and feeder lines, to Seattle, Tacoma and Portland. He intimated that one of the country's big railway systems would ultimately make use of the North Coast.

"It's the Chicago & Northwestern," said about one-third of the people that pretended to know. "The Northwestern is already half built to the coast from Chicago; it's taking this way of completing its system."

"You're wrong it's the Canadian Pacific, anxious to punish Jim Hill for invading Canada," said an equally strong party.

"You both are wrong," broke in some wise "students of railway affairs," as they were flatteringly called by the newspapers. "Can't you see that Harriman is building the North Coast to beat Jim Hill at his own game?"

There were stragglers who disputed all these assertions. Some said the Milwaukee was building this separate line to effect an entrance into Spokane, which is not on its main line, and into other cities and districts of the Inland Empire,

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as the plateau between the Cascade and the Rocky mountains is called. Still others insisted that the North Coast was an independent enterprise, while others maintained that the Strahorn road was impractical in its routings and designed merely to hold-up its competitors, with the object of selling out at a good figure. It is fair to say, however, that subsequent developments have discredited this last surmise, though nothing has happened to controvert definitely any other of the reasons advanced for the North Coast's existence.

But amid all these surmises, contradictions, reports, what did the moving spirit of the North Coast have to say? Did he deny or affirm? Did he refuse himself to inquisitive reporters sent out by city editors who had received sure tips? Not he! This part of his system of operation proved unique, as did the rest. He received each reporter with open arms and welcomed each suggestion that came his way. Was the North Coast a Milwaukee enterprise? Nothing could be more reasonable. The North Coast could give to the Rockefeller road just the connections it wished into Spokane, Walla Walla and the other Inland Empire cities. This was a most reasonable explanation.

The readiness with which this suggestion was accepted by the genial railway president was far from convincing, but Mr. Strahorn would bow out one reporter while another entered.

"Now, you can't deny that the North Coast is a Union Pacific enterprise, for we have direct information from Wall Street that Mr. Harriman is your real backer," says the second inquisitor.

"I can't take you into my confidence," is the reply, "but you have a most logical assumption. Mr. Harriman with the North Coast could gain a tremendous advantage over Mr. Hill in the struggle for this Northwestern territory. The North Coast will lead Mr. Harriman to just the places he desires to reach. In fact any of these competing railways would be glad to get the North Coast."

Wouldn't that sort of a retort baffle any reporter? Perhaps the same newsgatherer will be a visitor into Mr. Strahorn's office later in the day asking him to affirm or deny that his railway is not a blind extension of the Northwestern. "The Northwestern has been casting longing eyes in this direction, and could reach Washington with less mileage than any other of the middle western

THE PALOUSE FALLS.
A striking bit of scenery in the country of the "mysterious railroad."

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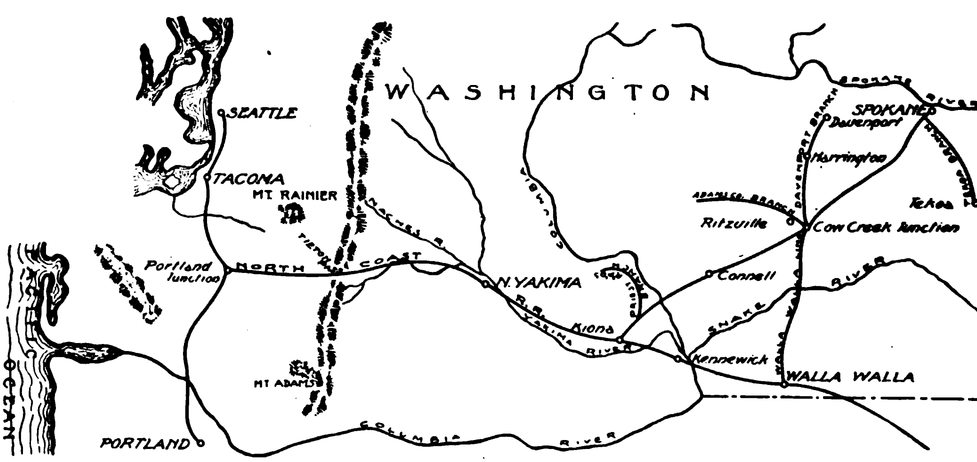
SITE OF THE SNAKE RIVER BRIDGE.
One of the streams to be crossed by the North Coast Railway.

systems," he replies, leaving the poor reporter still more bewildered.

At the same time Mr. Strahorn has said upon different occasions that individuals connected with his enterprise are amply able to build the road from their own pockets. Here is a list of some of the Eastern sponsors of the North Coast, according to its president: Henry J. Pierce, at the head of Buffalo's consolidated railways, and a stockholder in the International Railway of Canada, connecting Toronto, Niagara Falls, Buffalo and Rochester; J. G. White, president of the J. G. White Company of New York, railway builders and owners; Banker Frank A. Dudley of Niagara Falls, and several others not mentioned in "Who's Who."

"It should be easy enough to trace this man Strahorn to his hole," thought railway men who declared in their own mind that the president of this mysterious railway would not longer baffle their



MAP OF THE MYSTERY AMONG RAILROADS.
The North Coast line covers territory that many roads would give millions to control.

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shrewdness. "We will find out where his pay checks come from; that will tell the tale."

So they investigated, and found that the Strahorn paper passed through the Seaboard National Bank of New York, and that Moffit & White act as his brokers. But what did that indicate? Moffit & White did not care to make any comments on the situation; and the Seaboard National was keeping its mouth locked cific Coast. To complicate matters still more Mr. Strahorn once a week, at least, gives out an anonymous interview linking his road up with one after another of the various lines.

One thing may be taken as absolutely certain; Mr. Strahorn is not building a railway for James J. Hill. In fact, Mr. Hill is going to keep Mr. Strahorn from reaching the million dollar terminal sites he has purchased in Spokane—if he can.

WHERE THE ROAD WILL COST $150,000 A MILE.
The Palouse Canyon through which the North Coast Railway will run.

with a combination fastener. That's just where the whole matter stands today.

But it may not be supposed that the various systems linked by report with the Strahorn enterprise refrained from making announcement. The Milwaukee has taken occasion numerous times to insist that the North Coast is no part of its system, while prominent Canadian Pacific officials give statements to the newspapers disclaiming any responsibility for the enterprise. Every now and then one of Mr. Harriman's lieutenants chimes in with a denial, and the Northwestern formally announces that it has no immediate plans for reaching the Pa-

The North Coast crosses the Hill right-of-way several times leaving Spokane. If injunctions and court proceedings avail anything Mr. Hill is not going to stand for that. Mr. Strahorn is now facing the most serious legal fight of his career at Spokane. Agreements have been reached at certain other points.

Mr. Hill sees only one explanation for the North Coast—his deadly rival Harriman. He believes Harriman is the instigator and secret projector of the Strahorn road. And perhaps he is right, for one story told in Wall Street is to the effect that Harriman and the Rockefeller interests formed a secret pool for the joint construction of the North

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Coast, without even letting in their subordinate railway presidents on the deal. Constantly the alliance between the Union Pacific and the Milwaukee in the Northwest is becoming closer, which lends color to this explanation—but at that it is nothing more than a supposition.

That the North Coast is no ephemeral scheme is evidenced by the fact that real money is playing its part in the game. Not less than $6,000,000 has been spent to date in acquiring rights of way, terminals, advancing surveys, grading roadbed and constructing bridges. A contract has been let for a bridge across the Columbia River that will cost close to $1,000,000. In reaching the Spokane terminals—providing Mr. Hill doesn't keep him out—Mr. Strahorn must blast out acres of solid rock to a level of thirty feet below the street grade, and must then floor and wall the entire basin with concrete to keep out the seepage from the Spokane River.

Much of the country which the North Coast traverses on its Walla Walla and Seattle lines is extremely rough and renders railway construction most difficult and costly. Through Palouse Canyon the laying of rails will require the expenditure of $150,000 a mile. In crossing from central to western Washington Mr. Strahorn has secured in the Tieton Pass one of the lowest and most easily reached routes across the Cascade Mountains, which have proved a difficult barrier for railway engineers since the first survey for the Northern Pacific.

One peculiar feature in the North Coast's progress is that gradually the men who were associated with Strahorn in the beginning have dropped from sight—at least so far as their connection with the North Coast is concerned. Constantly has President Strahorn grown into a larger figure, until now the North Coast is Strahorn's road, in common parlance. He lives in a magnificent residence in Spokane, said to be the finest in that city for interior sumptuousness. From a couple of small rooms his offices have expanded until they occupy the greater part of a floor of one of Spokane's big business blocks. How much longer will this genius for concealment

PART OF THE NORTH COAST ROAD-BED.
No expense has been spared to prepare the way for the track.

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FIVE MILES OUT OF SEATTLE.

be able to withhold the secret of his backers?

There is one possible, though, perhaps, scarcely likely, solution of the mystery. May it not be the fact that Robert E. Strahorn controls an independent road, affiliated with neither the Chicago & Northwestern, the Milwaukee, nor the Harriman interests, and that he is making use of the fears of these big interests for one another to make secure his position? Not knowing where to strike they hit in the dark. This, of course, is only one of the many possible theories that the would-be puzzle solvers have advanced.

Gratitude

I've heard of hearts, unkind, kind deeds
With coldness still returning;
Alas! the gratitude of men
Hath oftener left me mourning.

—Wordsworth.

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NOISELESS WAR

By Chester Carton

NOW that ex-President Roosevelt is stealing through the jungles of uttermost Africa assassinating unsuspecting lions and things with his noiseless rifles, while a factory at Hartford, Connecticut, is hard at work turning out similar weapons for those who would emulate so distinguished an example, perhaps the public may be able to bring itself to believe in the reality of the noiseless gun. Yet it is difficult to readjust one's ideas to an invention so completely subversive of the established order of things.

To watch the play of expression on the face of a man accustomed to handling firearms the first time he shoots a noiseless gun is a treat. *He* knows the gun for the noisiest thing of its size on the face of the earth; and you can't stuff any nonsense about silencing it down *his* throat. Why, just listen!

When the pulling of the trigger is followed by nothing more ear-splitting than the snap of the firing mechanism he naturally assumes that there has been a misfire. Only by showing him the empty shell, which he knows to have been loaded when he placed it in the gun can he be convinced that it was actually fired. He can't help looking foolish, for that is the way he feels.

Now unscrew the silencer from the muzzle of the gun, hold a lighted match at one end and tell him to blow it out by blowing through the straight, open bore of that six-inch cylinder of steel, and he will look still more foolish, for he can't even make the match flicker. The harder he blows the more he can't blow it out. Truly, a remarkable little device, that silencer. And the most irritating thing about it is to find results so wonderful accomplished by means so marvelously simple as, upon examination, are found to be employed.

All in the world there is of the silencer is a steel cylinder 6⅝ inches long by 1 5/16 inches in diameter and weighing 12 ounces for the Springfield rifle. In the muzzle end of the cylinder is an expansion chamber. Beyond this there are eleven spiral convex vanes or disks with the outer edges turned back to form a sort of cup and having a hole a trifle larger than the bore of the gun a little to one side of the center, for the silencer is mounted off center so that the greater parts of its diameter hangs below the top of the barrel out of the line of sight. The silencer is screwed on to the muzzle of the gun by means of interrupted threads so that it can be attached and detached by a quarter turn. If the man who is using the gun wants to prepare to receive a charge or its otherwise in a hurry he can take off his silencer and fix his bayonet in about four seconds.

The principle on which the silencer is based is that of centrifugal force, or the property possessed by rapidly rotating bodies of flying out from the center. When a rifle equipped with a silencer is fired the bullet passes through the slightly larger bore of the silencer without any loss of velocity, accuracy or penetration. Anyone who has watched the column of smoke and steam shoot out of the smokestack of a locomotive which is working hard, the column begin-

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ning to expand the instant it leaves the upper edge of the stack and mushrooming as it ascends, has seen a rough sketch of the way the powder gases act on leaving the muzzle of an unsilenced gun. The report of the rifle is due to the sudden liberation of these gases upon the base of the bullet leaving the gun. The gases rushing out expand into mushroom form, their impact upon the air causing the sound of a blow, exactly as the column of steam leaving the smokestack at much lower velocity causes the characteristic snort of the locomotive.

The Threaded Muzzle to Which Silencer Is Attached.

The exhaust of the gas engine was muffled long ago; and the inventor, who had had some years' experience in automobile engineering thought he could silence a gun on the same principle that the gas engine is muffled. It cost him a vast amount of wasted time and energy to find that he was on the wrong track.

The Silencer.
It is screwed onto the muzzle of the gun.

The instant the powder gases have pushed the bullet out of the muzzle of the gun they have done all they can do and are of no further use, but on the contrary a nuisance to be gotten rid of if possible. The expansion chamber of the silencer is placed next to the muzzle to trap them at the earliest possible instant. The outer edge of this enlarged column of gases is caught by the first of the spiral vanes, which has a lug on the lower side engaging in a slot in the cylinder, to keep it from turning, and this starts the periphery of the column to whirling very rapidly on to the next disk. The eccentric motion due to the spiral vanes being off center causes the leading portion of gas to cut a slice at right angles off that part of the pencil of gas which is trying to follow the bore, so that the mass reaches the space between the next two vanes with diminished velocity. More and more of the column of gas is cut off and set to swirling and expanding until its energy is so far spent that it is no longer capable of causing a racket as it pours tamely out of the silencer.

Neither moving parts nor delicate mechanisms are used to accomplish this result, and there is nothing to wear or get out of order. Neither is any change required in any gun to adapt it to the silencer other than cutting a short screw thread on the muzzle. There is no interference with the shooting qualities of the gun, since the bore of the barrel is not disturbed and the bore of the silencer is larger than the bullet which passes through it, giving a clearance which avoids any possible effect on accuracy or penetration. Neither is it possible to choke up the silencer with gases by continuous rapid firing, for the experiment of emptying a magazine as fast as the gun could be fired has been repeatedly tried with no other effect than the heating of the silencer.

That sound actually is silenced has been proved by some rather elaborate experiments. Lest enthusiasm should unduly bias the verdict of the senses if the judges were to stand beside the men who did the firing they were sent out in an auto out of sight of the firing party. Arrangements had been made to fire a certain number of shots without the silencer, at stated intervals which would allow the judges ample time to reach designated points, the last of which was believed to be beyond the sound of firing. When the test was carried out it was ascertained that the Springfield rifle with which the United States Army is now equipped could be heard at a distance of three miles and a quarter.

After definitely losing the sound of the firing the judges turned back, stopping at prearranged points at specified times to try to pick up the sound of the

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guns which were now being fired with the silencers attached. Nothing could be heard until the judges arrived within three-quarters of a mile of the firing party. According to this test the silencer eliminated only seventy per cent of the sound produced by the gun.

However, the sound heard by the judges was not produced by the discharge of the gun but by the passage of the bullet through the air. The air comes together with a crash into the vacuum created by a missile traveling at a speed exceeding 1,400 feet per second, and the bullet of a Springfield rifle leaves the muzzle with a velocity of 2,700 feet per second; the effect being like that produced by a flash of lightning. There was this curious difference between the sound of the discharge and that caused by the bullet: the former could be definitely located while the latter could not. To verify this odd fact the judges took up a position in the center of the field while rifles were fired at various points around them. Not only were they unable to tell from what direction the sound came, but no two agreed in their impressions.

Hiram Percy Maxim.
Inventor of gun report silencer.

Finally the effect of the silencer on the noise of discharge was tested by a method beyond the influence of prejudice or imagination. The verdict of an elaborate sound-recording apparatus was, that the noise produced by the discharge of a service rifle was equal to that caused by clapping the hands. In other words the silencer eliminated 97 per cent of the sound of discharge of a service rifle. For smaller guns the silencer is still more effective, there being absolutely nothing to be heard but the click of the firing mechanism of a .22 caliber target rifle.

The largest size made at present is for the .405 rifle. Ex-President Roosevelt took one of these and one for a .30-40 rifle on his African expedition. But the inventor, Hiram Percy Maxim, hopes soon to have a silencer for field guns ready for use, after which he will devote his attention to silencing ten and twelve-inch guns; for he aims at nothing less than rendering future wars noiseless.

The possibilities of such an achievement are too tremendous to be readily grasped. It is the fashion to proclaim every new invention pertaining to warlike appliances as destined to "revolutionize" war. A great many such inventions have been produced in the last quarter of a century, yet war remains the same unrevolutionized exhibition of elementary passions that it always has been. Whether the Maxim gun silencer will produce that result or not, it is at

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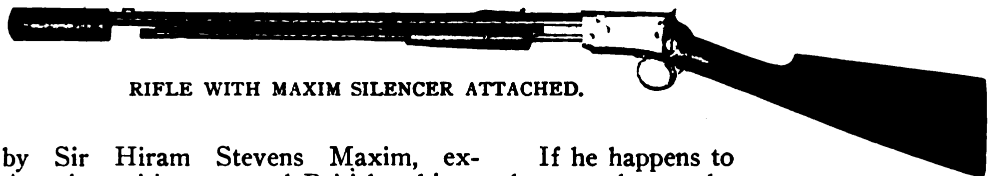
least safe to predict that it is destined to have a more important bearing on man's favorite pastime of slaughtering his fellow man than all the other inventions of the Maxim family combined. These include the Maxim machine gun in general use throughout the world, smokeless powders and Cordite, a high explosive,



RIFLE WITH MAXIM SILENCER ATTACHED.

by Sir Hiram Stevens Maxim, ex-American citizen, turned British subject, the father of the inventor of the gun silencer; Maximite, another high explosive, and a torpedo also in general use, fuses, smokeless powders and other inventions by Hudson Maxim, his uncle; and sundry improvements in firearms by Isaac Maxim, his grandfather.

The Spiral Vanes of the Silencer.

To begin at the beginning of the chapter of changes to be wrought by the noiseless gun, the first and most obvious effect will be to popularize rifle shooting by making it a pleasant pastime rather than an affliction to the community, with the result that the soldier of the future will be able to hit something occasionally. The average civilian is gun shy, and not without reason; for the ear-splitting crash accompanying the discharge of a rifle is so distressing that seasoned soldiers wear ear protectors or at least stuff cotton in their ears at target practice. Heavy firing on shipboard is worse. Many a man is drawing a pension because his hearing was destroyed by the sound of firing.

Moreover, the recoil of a modern high power rifle is so great that to fire one is almost as disastrous as being kicked by a mule. The noise and the recoil together cause the average man to shoot like a woman; that is, he shuts his eyes, grits his teeth and flinches as he pulls the trigger, to the greater peril of any stars that may happen to be in range than of any terrestrial target. The silencer does away with both causes of flinching; for the same pressure against its spiral vanes which kills the sound pulls the gun away from the shoulder hard enough to neutralize the recoil. With noise and kick eliminated, the man behind the gun will be encouraged to look at what he is about and thus may be able to do vastly more execution.

If he happens to be a cavalryman he will not need both hands to hang on to his horse by, if he uses the silencer. Cavalry horses are only too often as gun shy as the rawest recruit; and when the two are combined they can perform prodigies of inefficiency. Perhaps the confident predictions of the terrible things the Russian cavalry would do to the Japs in the last war and the brilliant thoroughness with which it did not fulfill the prophecies may be recalled as a case in point.

Nor are these all the direct results accomplished by the gun silencer. When a rifle is fired at night a jet of flame as large as a man's hand flashes from the muzzle. This flash is visible for a long distance and is apt to attract disagreeable attention if there happens to be anybody around who objects to being shot at. But when a rifle is fired with a silencer attached the flame is totally suppressed.

With his invisible uniform of olive drab, smokeless powder and noiseless gun, the soldier would seem to be about as completely equipped for killing without getting killed, which is the whole art of war, as it is possible for human ingenuity to make him. Noiseless war will be simply assassination on a large scale. An ambush properly placed can utterly destroy any force that marches into range without giving a sound to betray its location to its victims. Sniping parties, by exercising skill in selecting cover, with neither smoke nor sound to

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betray them, can pick off the enemy until they become surfeited with killing. The only indication of their activities will be the dropping of their victims with nothing visible or audible to indicate from whence death came.

Masked batteries equipped with silencers will be masked in fact as well as in name instead of exposing their exact location by the roar of the first volley. Secured from all chance of discovery by the use of smokeless powder and the silencers they can mow down regiments at their leisure, diverted meanwhile by the spectacle of the enemy training their guns on every spot but the right one in fruitless efforts to find their silent foes.

Night attacks will indeed be surprises; for a picked band of assassins with their noiseless rifles can slaughter the pickets on a whole army's front without giving the alarm, while the main body also equipped with noiseless guns following close behind can make the massacre complete ere their sleeping victims awake.

A pitched battle with noiseless guns will be as decorous as a dress parade. With the fearful rattle and roar of small arms and field guns abolished officers will be able to make themselves heard and so to direct the fire of their men. More execution can thus be done in a given time with much smaller expenditure of ammunition. Battles may also be briefer, for without the crash and din to drown them, the shrieks and groans of the wounded may be heard plainly enough to produce demoralization, panic and flight.

The Inventor Giving a Demonstration.

In fact the advantages of Maxim's silencer from a military standpoint are so numerous that they will simply compel recognition; and the work of fitting them upon the world's armament of eighteen million rifles may be expected to begin as soon as the world can raise the money to pay for them. For so long as nations continue to spend all the money they dare extort from the people

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on preparations for war, and so long as those same people devote a large part of their time to telling how easy it would be for them to lick some other nation there will be wars in spite of all the Peace Congresses and Hague Tribunals that can be assembled. Young Maxim knew what he was about when he abandoned the automobile, which only kills in a petty retail way, and took a short cut to fame and fortune by inventing a device that will facilitate the slaughter of tens of thousands.

It has been objected that the silencer will be a boon chiefly to game hogs, but the game hog had contrived practically to exterminate all game before the silencer was invented. It has also been objected that the silencer was an aid to assassination, since it would allow no sound to betray the assassin. But it must be conceded that the impunity with which murder can be committed in the United States would seem to indicate that it is no longer regarded as a crime. Besides, a rifle is too conspicuous a weapon for the assassin, and the silencer, fortunately, does not work on a revolver.

The Exile's Song

The palm-tree waveth high,
And fair the myrtle springs,
And, to the Indian maid,
The bulbul sweetly sings.
But I dinna see the broom
Wi' its tassels on the lea,
Nor hear the lintie's sang
O' my ain countrie!

* * * * * *

There's a hope for every woe,
And a balm for every pain,
But the first joys o' our heart
Come never back again.
There's a track upon the deep,
And a path across the sea;
But the weary ne'er return
To their ain countrie!

—ROBERT GILFILLAN.

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Putting Windows *in* Sightless Eyes

By C. F. Carter

TO cause a blind man to see by inserting in his sightless eyeball a segment from the eye of another creature just as a glazier puts a pane of glass in a broken window is a feat which with perfect propriety may be characterized as remarkable. Such a triumph was recently achieved by Dr. Henry R. Lesser, a young New York oculist, almost before the ink on his diploma was dry. The fact that corneal transplantation was first successfully performed nearly a quarter of a century ago detracts nothing from the interest of Dr. Lesser's achievement, for the operation is extremely rare, first because of its delicacy and difficulty, and, secondly, because there are very few cases in which it would afford relief. In fact the graybeards among the profession still regard corneal transplantation as a laboratory experiment rather than as an established practice.

The patient was a Russian aged twenty-four, who had been blind since he was nine years old as the result of an attack of measles. His right eye was entirely useless; but Dr. Lesser found a dense leucoma, which is an affection of the cornea that renders it opaque and makes it look like a bit of ground glass, in his left. This is the only condition

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that can be benefited by transplantation of the cornea, so far as the surgeons now know, and by no means all cases of leucoma are susceptible of improvement. The leucoma must be total and without complications. Even when outward indications seem to promise success the surgeon is by no means sure that he will not find complications that will defeat him when he cuts into the cornea, the horny, transparent concavo-convex disk which forms the anterior fifth of the globe of the eye, and which fits into the sclerotic, or fibrous coat, covering the rest of the eye's surface as a watch crystal fits into its frame. He is justified in taking long chances only by the certain knowledge that no other hope of relief remains and that the patient thus has everything to gain and nothing to lose. The young Russian declared that the operation would be worth while even if he was enabled to see for only a few months so Dr. Lesser determined to go ahead.

As a preliminary the patient was given one grain of mercury with chalk three times a day for two days. On the night before the operation his left eye was bound up with a bandage saturated with a solution of one part of bi-chloride of mercury to two thousand parts of water. When all was ready the eye was very carefully washed and then cocaineized. The cocaine deadens the pain of such an operation as effectually as chloroform or ether without the danger of making the patient sick or causing some movement that may displace the graft.

The next step was to cut a tiny disk about as large as the end of a .22 caliber

ELLSWORTH YOUNG

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cartridge out of the opaque cornea as a carpenter might cut a hole in a blank wall to make room for a window. But no carpenter ever used so delicate an instrument as Dr. Lesser employed to dispel the perpetual darkness in which his patient dwelt. This was the von Hippel trephine, invented by Prof. von Hippel, of Germany, the first man who performed the operation successfully. The von Hippel trephine has a shaft about as large around as a lead pencil and two-thirds as long. On its end is a very sharp steel cutting ring with an adjustable collar which regulates the depth of the slice to be taken out of the eye. Great care is necessary in adjusting the depth of the cut, for if Descemet's membrane, a tough elastic membrane lying behind the horny plate of the cornea, is penetrated it will admit aqueous humor behind the graft which renders it opaque and ruins all hopes of sight. The cutting ring is revolved at high speed by a clockwork mechanism at the other end of the shaft contained in a barrel as large as a silver quarter and about three-fourths of an inch deep. It is started and stopped by pressure on a button.

The surgeon held the cutting edge of the trephine squarely against the eyeball of the patient, there was a shrill hum as the tiny saw revolved for a second, a pause, another hum and the instrument was laid aside. Delicate as this process was it was nothing to what was to follow. The disk had only been blocked out; the next step was to cut it away from Descemet's membrane. These parts of the eye are very tender and they bleed at a

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touch. While an assistant stood by with pledgets of cotton to wipe away the blood Dr. Lesser took hold of the edge of the disk with a dainty pair of curved forceps with his left hand while with his right he carefully but swiftly cut the disk loose. A steady nerve and a sure touch were needed, for a mistake of a hair's breadth meant failure.

It was soon done. The useless disk was laid aside and the surgeon with swift precision began to prepare the graft that was to take its place. This was a disk of the same size to be cut with the same trephine from the eye of a nine months old rabbit which had been placed under the influence of ether and prepared for the operation. It would not do to kill the rabbit until after the operation, for an operation in Europe some years ago in which the rabbit died from the effects of the ether before the graft had been cut from its eye was a failure. Whether the death of the rabbit had anything to do with the failure or not surgeons prefer to take no chances.

Even greater care was necessary in manipulating the tiny disk from the rabbit's eye than in removing the worthless fragment from the eye of the patient, for the graft was to live and let in light. One false touch, however slight, meant ruin. The disk was quickly cut out without mishap and then while the surgeon dextrously transferred it to its new owner an attendant with a fresh application of ether sent the rabbit to join the hosts of its kind that have been martyred in the cause of science.

The graft was inserted by holding it

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in the trephine and then pushing it into its place in the patient's eye by means of a tiny glass rod through the tube of the trephine. As soon as the graft was fitted nicely in position the eyelids were closed and a pressure bandage applied to hold it in place until it had a chance to grow fast.

Forty-eight hours later when the bandage was removed the graft was found to be solidly in place and slightly hazy. A glass conform was inserted between the eyelids and the eyeball to prevent undue pressure and the danger of disturbance of the graft when the lids were separated again and the bandage replaced for four days more. The patient suffered very little pain or discomfort from the effects of the operation.

On the sixth day two small blood vessels were found extending over the cornea and the graft. These disappeared in due time of their own accord and in a few more days the graft had become a part of the eyeball. It remained slightly hazy but kept gradually clearing until the patient returned to Russia and so passed out of the knowledge of the surgeon.

The result of the operation at last accounts was that the patient could count fingers held a foot from his face and could distinguish objects well enough to get around with little trouble. He said he was "beginning to learn colors again."

The first attempts to transplant sections of the cornea were made by Dr. Dieffenbach in 1824, but they were unsuccessful. Other attempts were made and after exhaustive experiments in 1880 the thing was declared impossible. But

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Prof. von Hippel, after ten years of study at the great clinic at Giessen, Germany, where more than two thousand patients were treated and some five hundred major operations were performed annually, and after many experiments on animals, concluded to try his hand at it. His first three attempts, in which the grafts were cut from the eyes of dogs, were failures. Then he decided to use smaller animals so that he could utilize the entire thickness of the cornea. The patient by his own misconduct spoiled one attempt and three other failures were due to errors of the surgeon. But the next four operations restored sight.

But the rarity of the cases which can be helped by a corneal graft may be judged by the fact that but three cases have appeared at the New York Post Graduate Medical School and Hospital in fifteen years. All three were operated on by Dr. Francis Valk, Professor of Diseases of the Eye. Although but one was successful Dr. Valk expressed himself as convinced of the value of the difficult and delicate operation.

The most remarkable case of corneal grafting on record was performed in November, 1906, by Professor Zirm, of Vienna. By a rare coincidence there was in the hospital at the same time a patient whose eyes had been so badly burned by lime that he was totally blind and a boy who had to have an eyeball removed. Professor Zirm timed the removal of the boy's eye so that he could cut a disk from the cornea to be transplanted on the eye of the blind man. The sight of one eye was fully restored.

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THE POISON SQUAD STARTING OUT FOR A DAY'S FIGHT ON THE MICE.

A PLAGUE OF FIELD MICE

By HARRY H. DUNN

FIFTEEN thousand acres of alfalfa, out of a total of 20,000 acres in the Humboldt Valley, Nevada, totally destroyed; farmers forced to replace crops yielding $60 to $70 per acre with other crops bringing in $35 to $40 per acre; a dead loss of $20 per acre on the entire area, or a grand total of $300,000 known loss—this is the result of the first great mouse plague the United States has ever known.

A few days of hard thinking, following a few days of expert investigation, both carried on by the men of the Biological Survey of the United States government; the application of a few thousand pounds of alfalfa hay, soaked in a poison solution, and the plague of rodents was conquered, the farmers of the great and fertile Humboldt Valley taught how to meet repetitions of the invasion in succeeding years, and the farms successfully insured against what appeared at first to be an unconquerable foe.

Beyond this, the doctrine of protection to hawks, owls, ravens, crows, shrikes, sea gulls and other rodent-eating birds, as well as weasels, skunks, foxes, coyotes, badgers, and wild cats, all of which prey on mice, was thoroughly instilled into the minds of the ranchmen. By this one lesson alone, Nature's predatory creatures will save to Nevada farmers thousands of dollars each year, which would otherwise be spent in keeping down the crop-eating mice.

The Humboldt Valley is in the northwestern part of the state of Nevada. It is one of the most fertile and productive valleys on the American Sahara. In it are located many pretty towns, rapidly growing into cities. Practically all of these towns are fed and supported by the surrounding ranches, whereon alfalfa is the largest crop, closely followed by dairying interests, also dependent on alfalfa, and by orchards of fruit trees, which the mice were just beginning to attack when the plague was checked.

It follows from this statement that the

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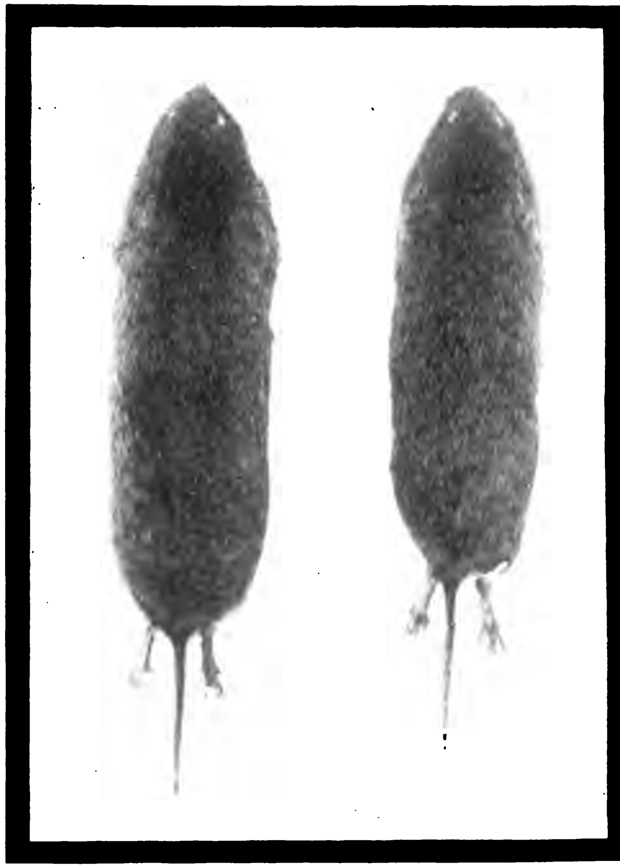
existence of all these towns, from Battle Mountain on the east to the sink of the Humboldt River on the west, was threatened. In this area there are more than thirty villages, towns and small cities. Lovelocks, around which the fight with the mice plague was most fiercely waged, lies about in the center of the valley, and, when the work was undertaken by government experts, the little rodents were spreading in every direction from the starting point.

In May, 1907, fields on the Rodgers ranch, five miles below Lovelocks, were invaded from less cultivated lands further up the valley. The movement of this great body of mice, multiplying with incredible rapidity, was gradual and slow, not like the sudden settling down of an immense flight of locusts. They scattered by progression, first by a few, and later by increasing numbers, so that the work of the few, done underground, and scarcely noticed at first, became in a few days an utter devastation worked by the thousands of young growing to maturity.

Numbers of the ever-growing population of rodents, in turn, moved out to fields on all sides, and, finding the forage improved, started colonies of their own, and so on, *ad infinitum*. By fall of the same year a large part of the cultivated lands around Lovelocks had been overrun by the mice. Not alone did the farmers become alarmed, but the people of the towns themselves, dependent on the products of the farms for their industries and their very livelihood, were all but terrorized. The Pied Piper of Hamlin, had he appeared, would then have been the most welcome arrival these cities of the pretty Nevada valley could possibly have seen.

The yield of hay, in this brief period, from May to October of the same year, was reduced one-third; potatoes and root crops were largely destroyed; many alfalfa fields were ruined by the mice changing their attacks from the green tops of the earlier part of the season to the roots, and the complete destruction of this latter, the chief crop of the valley, was threatened.

In November, at the height of the plague, it was estimated that each acre of the infested district contained from 8,000 to 12,000 mice. Great cracks, as from some giant earthquake, appeared throughout the ranches; the fields were riddled by the mouths of the tiny rodents' burrows, which in many cases averaged 150 to 175 to the square rod. Ditch embankments were mere sieves, irrigation was tied up where not entirely



THE COMMON FIELD MOUSE.
The rodent which cost the Nevada farmers many thousands of dollars.

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Alfalfa Plant Destroyed by Mice.
This is a favorite food of the pest.

ruined, and the scene on the erstwhile prosperous ranches was one of devastation.

But the worst was not yet. The serious hay and other crop losses of the summer proved but slight forerunners of the damage which was to be worked with the disappearance of green food in the fall. Burrowing down about the plants and extending their runways from root to root, the mice either completely killed or seriously injured the alfalfa. Soon they destroyed so much of the acreage that thousands of acres were plowed up as hopelessly ruined.

In the orchards the little rodents adopted similar tactics, going down to the roots of growing fruit trees and totally destroying acres of promising fruit trees. Most of the young shade trees planted along roads and irrigating canals met the same fate, while large Lombardy poplars, of years' growth, were girdled and eventually died.

By spring of the following year, 1908, the mice had made such a clean sweep of the fields and orchards about Lovelocks that they moved on down the valley, very few, possibly two or three hundred remaining to each acre of the old haunts, where once had been thousands. Their first inroad extended to an irregular line across the valley about six miles below Lovelocks. Now they began their work of devastation on the equally fertile fields below this line. During the spring they attacked every available food supply, willows and even greasewood bushes out on the desert failing to escape their sharp teeth. They sought more especially, however, the alfalfa fields, sweeping their path clean of the valuable crop and ruining the great fields of roots from which the green hay springs perennially.

The attack found the Nevada ranchers totally unprepared. In the language of the street, they did not know "what they were up against." No previous examples of the controlling of such plagues existed. Where mice have invaded agricultural areas, particularly in the Old World, they have been allowed to run their course until brought to an end by natural agencies, such as the failure of food supply, action of the elements, or some other cause over which man had no control.

Orchard Tree Killed By Mice.

In Humboldt Valley, therefore, no concerted action was taken against the plague in the early stages because the ranchers did not realize the extent to which it would grow, and,

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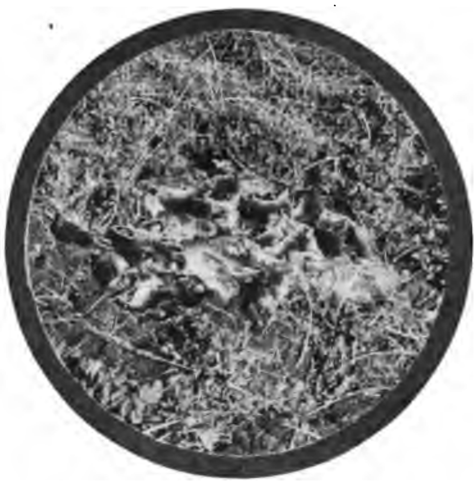
later, because its size overawed them, and they had no idea how to meet it. Sporadic attempts were made to kill off the mice with poisoned wheat, made deadly with solutions of phosphorus. This method was found, however, to give poor results, as the fields so cleared were quickly reinvaded from neighboring acreage and no concerted effort was made to put out the poison all over the valley.

More than this, it was found that while the preparation, which consisted of wheat treated with a strong solution of phosphorus in carbon bisulphide, was a cheap and effective poison for the mice in limited areas, it was inflammable, explosive, and dangerous to birds. As a result of its employment on many of the ranches in the valley, California quail, introduced by sportsmen, were all but wiped out; magpies, crows, meadow-larks, and other smaller and highly beneficial birds, were sadly decimated. The birds of prey, which killed thousands of the mice, were not affected, but many skunks and domestic cats were found dead as a result of eating mice which had been killed by the poisoned grain. In addition, several accidents occurred to men as the result of handling the phosphorus and much live stock was poisoned by eating the grain both before and after it had been scattered. Bacterial preparations, with which it was sought to inoculate the rodents, failed entirely to make any noticeable impression on the horde.



Effect of the Poison Crusade.

One man, however, came to the front, and, with his co-operation, the biological survey was able to completely conquer the plague. This man was George S. Webb, manager of the large Rodgers ranch, where 2,000 tons of alfalfa had been lost through the depredations of the mice. Experiments conducted showed that alfalfa hay, poisoned with strychnia sulphate and distributed over all the ranches at the same time, effectively disposed of the problem. Further than this, the experiments showed that similar plagues could not alone be wiped out once they had started, but could be absolutely controlled in the beginning.

On two ranches, the Rodgers and the Anker alfalfa farms, men, varying in number from seven to fifteen, were employed distributing the poison with most satisfactory results and without the dangers incident to the distribution of the phosphorus-poisoned grain. It was found that the salaries and expenses of these men were a mere bagatelle compared to the result accomplished by their labors in the wiping out of the pest.

These experiments were undertaken in January, and by March 15, poisoning, supplemented by the work of predatory birds and mammals during the winter months, had completely destroyed the mice on several thousand acres where they had been found most abundant at the height of the plague. By May the mice which still remained in small numbers in scattering centers in outlying fields were found to be steadily decreasing, and, later in the summer, had practically disappeared from the entire valley.

At the same time that the mice appeared in the lower Humboldt Valley, the little rodents appeared in enormous numbers further up the Humboldt River and its tributary streams, about Winnemucca, Battle Mountain, and in the Paradise and Little Humboldt valleys. Here the crop chiefly attacked was red top and wild clover in natural meadows. On this account the damage was less severe, as the crop was less valuable. Gardens and scattered alfalfa

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fields, however, were quite seriously injured.

Later, alarming reports of mice in terrifying hordes were received from King River, Quinn River, and Carson and Smith valleys, Nevada; from Weber River Valley and from Sanpete and Utah counties, Utah; as well as from Honey Lake Valley in California. The damage in none of these places was so severe as in the lower Humboldt Valley, though plagues of like magnitude were plainly threatened, and would have occurred had not the knowledge of how to combat the rodents been fore-obtained.

In Carson Valley, one hundred miles southwest of Lovelocks, in April, 1908, a similar plague of mice was put down by the use of alfalfa steeped in strychnia sulphate, in exactly the manner learned by experiments in the Humboldt Valley. A peculiar feature of the Carson Valley plague, however, was that the nests when opened were found to contain almost twice as many young as did similar nests in the Humboldt Valley. Mortality from natural causes was not so great as in the latter section, either, and these two factors combined resulted in such a rapid increase of the rodents that the danger was much greater than in the first plague with which the experts had to deal; though, as has been said, it was eventually conquered.

The species of mouse responsible for the plague is the one known locally in the West as the "black mouse." Scientists have given it the name of Carson field mouse—*Microtus montanus*—one of the numerous species of short-tailed field mice or meadow mice, a group which has caused widespread destruction in various parts of the world. This mouse is widely distributed, though usually in small numbers, throughout the valleys of Utah, Nevada, eastern Oregon and northeastern California.

DRAGGING FIELDS WITH BRUSH TO FILL UP BURROWS MADE BY MICE.

Field mice of various species are abundant throughout the United States, but not generally present in such numbers as to do noticeable damage. The Humboldt Valley plague, then, shows, that where conditions are exactly suited to their sudden and enormous increase, these mice may at any moment become the source of great trouble to farmers. The Biological Survey expects future and more disastrous outbreaks, as the West is settled and the large areas, on which the mice are now barely able to subsist, become filled with fields of their favorite food.

Of all repressive measures poisoning seems the best, inoculation with bacteria having proved futile except in isolated cases. Strychnine, phosphorus, lead acetate, mercuric chloride, and arsenic in its many compounds were tried, and every test gave strychnia sulphate as the best posion and the most practicable for use against the mice. Directions for preparing alfalfa—which was found to be the best vehicle for the poison, and, at the same time, the best bait for the

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CRACKS IN THE SOIL CAUSED BY FIELD MICE.

mice—in strychnia sulphate were given the ranchers by the experts of the Biological Survey as follows:

"Poisons should always be prepared at a distance from the house, where stock and poultry are not endangered. To avoid danger to persons, strychnine and the vessels in which it is used should, of course, be carefully handled and safely stored away when not in use. Ordinary five-gallon oil cans, for which covers and wire handles have been pro-

EFFECT OF DRAGGING BRUSH OVER FIELD OVERRUN WITH MICE.

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vided, make excellent utensils. A fire-hole about two feet long and a foot wide, over which two iron rods are placed to support the cans, makes a fireplace where the solutions can be quickly prepared. Galvanized iron washtubs are suitable for mixing the material if grain be used. For preparing alfalfa on the large scale usually necessary, a large metal receptacle which will permit the mixing of thirty pounds of hay at once is required. One or two oil cans marked in gallon measures, a sprinkling can, and several large, strong spoons complete a handy outfit for preparing the mouse poison."

A single treatment of alfalfa hay so poisoned resulted in the death of from 85 to 95 per cent of the mice in each field treated. The hay used was fresh and green rather than bleached, and was either chopped, or the fine material from the base of the stacks was used. The formula used so successfully was:

Chopped alfalfa hay.......30 pounds.
Strychnia sulphate .... 1 ounce.
Water .... 5 or 6 gals.

When properly soaked in the mixture, and the hay saturated with the solution, it may be taken up and sacked and stored away, though results are better where only enough of the preparation is made at a time for the immediate needs of the poisoning squad.

It was found to be best distributed by hand, placing a small pinch, say a teaspoonful, near the entrance to each burrow, and scattering a little here and there along the surface trails. In cold weather, when the mice remain most of the time underground, it should be dropped inside the entrances of the burrows. It is estimated that about forty per cent of the mice which eat this poison die on the surface, the remaining sixty per cent perishing in their nests. The amount of strychnine in the alfalfa is so small that danger to cattle is practically eliminated, and no trouble was experienced from this source in Nevada.

In the Carson Valley, in April, poisoning with *green* alfalfa was found most successful. The mixture used there was as follows:

Green alfalfa ....45 pounds.
Strychnia sulphate .... 1 ounce.
Water .... 1½ gals.

This green hay is declared to be better for small areas and the dry alfalfa better for large districts. The green shoots are especially valuable for destroying the mice along irrigating ditches and about the borders of fields during periods of irrigation in summer.

In fields in which some of the mice had migrated, leaving thousands of old and unoccupied burrows still scattered among the occupied ones, it was found practicable to run a brush drag over the land, obliterating the entrances to all the burrows. Then, very shortly, the mice came out, opened up the occupied burrows, and the matter of placing poison was much simplified and cheapened. In fact, the cost of destroying the mice with poisoned alfalfa hay over this area was reduced to about thirty-five cents an acre, an insignificant sum when compared with the damage done by the rodents thus killed.

Irrigation and winter flooding, when aided by small dogs which kill the mice when the latter are driven from their burrows, were found to be two effective methods of disposing of the rodents, while burning of dry cover and the plowing up of lands not usually tilled destroyed the homes of thousands, forcing them out where they could be killed. Clean cultivation, with thin wooden wrappers placed around the trunks, was found to be the best method of saving orchard and ornamental trees from the sharp teeth of the mice.

All in all, the Nevada mouse plague, while expensive and destructive of much hay and many trees, has served as one of the most valuable object lessons ever given the farmers of the West. It has also taught them, not alone to expect other such outbreaks from time to time, but exactly how successfully to combat them when they do come.

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Publicity Stops Railway Accidents

By Samuel O. Dunn

Western Editorial Manager, Railroad Age Gazette.

THE most pitiful sight I ever witnessed was that of almost seventy-five people who had been terribly scalded, many of them fatally, in a railway wreck near a small station in a western state. The engineer of a freight train on a single track line was ordered to run on a certain siding and stay there until a fast passenger train, running late, had passed. The engineer thought that by speeding up he could get to the station beyond the one where he had been told to wait before the passenger train came along; and, in deliberate violation of his orders, he pulled the throttle of his engine open and set out. Midway between the stations he met the passenger train running sixty miles an hour in the opposite direction. The trains telescoped, and of the twenty-one people who were killed and the fifty-three who were injured, practically all owed their death or injuries to scalding by steam from the locomotive.

Now, the facts stated show that the management of the railway was not to blame for this wreck. It was due solely to an employe's violation of orders. But the management so contrived things that it got all of the odium. When rumors of the wreck came in the Kansas City daily newspapers sought information about it at the railway offices. They were refused it, so the afternoon papers came out with "stories" under big, black headlines, that from one hundred to two hundred people had been killed, and twice as many injured. When a wrecking train, and later a relief train, were sent out, the newspapers asked leave to send reporters on them. These requests also were refused. Denied all official information as to the cause or results of the accident, unable to get correct details themselves, the morning newspapers, like the afternoon newspapers, published long, inaccurate accounts, describing in harrowing detail the terrible sufferings of the victims of the wreck; laying the entire blame for it on the officials of the road; and denouncing them for incompetency and

JULIUS KRUTTSCHNITT.
The man who stops railway accidents by telling the truth about them.

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A DISASTROUS PASSENGER WRECK.
Though lives cannot be restored, yet publicity makes heavier the punishment of the guilty.

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CLEARING A BADLY BLOCKED TRACK.
Somebody blundered, and it will be the committee's business to find out who.

for mercenary failure to provide proper safeguards for the protection of their patrons.

This incident illustrates the main cause of eighty-five per cent of railway accidents—viz., the violation of rules and orders by employes; and also the peculiar manner in which the railways have usually in the past tried to suppress information about accidents, and the way that this has tended to arouse public hostility against them. Public sentiment on this subject is aptly indicated by the saying that the best way to stop railway accidents would be to make railway officers ride on the locomotive cow-catchers.

During the ten years 1897-1907 the traffic on American railways grew with unprecedented rapidity. As the traffic grew the number of fatal accidents increased proportionately. The accident problem took on the most terrible proportions. Hardly a day passed that the newspapers did not spread over their first pages the gruesome details of some fatal wreck. It seemed to most railway operatives that accidents were getting a great deal too much publicity for the good of the roads. But the thought came to the operating head of one great system that perhaps the trouble was, not that they got too much publicity, but that they did not get enough of the right kind. The man in whose mind this idea was implanted was Mr. Julius Kruttschnitt, Director of Maintenance and Operation of the Union Pacific, the Southern Pacific, the Oregon Short Line, and the Oregon Railroad & Navigation Company—the roads familiarly known as the "Harriman Lines;" and it germinated and grew until it resulted in the adoption by these roads of an accident policy that is entirely novel. The Harriman lines now not only do not try to suppress the facts about their accidents,

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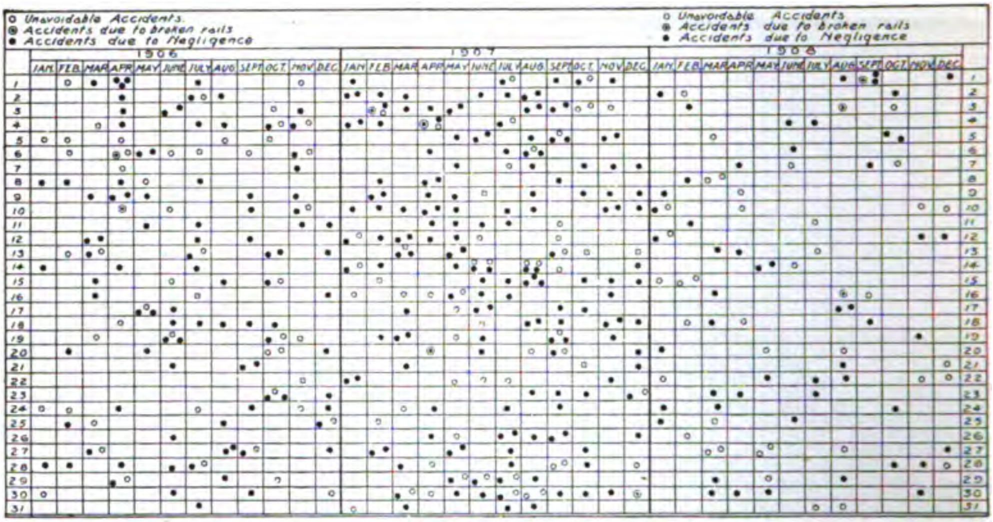
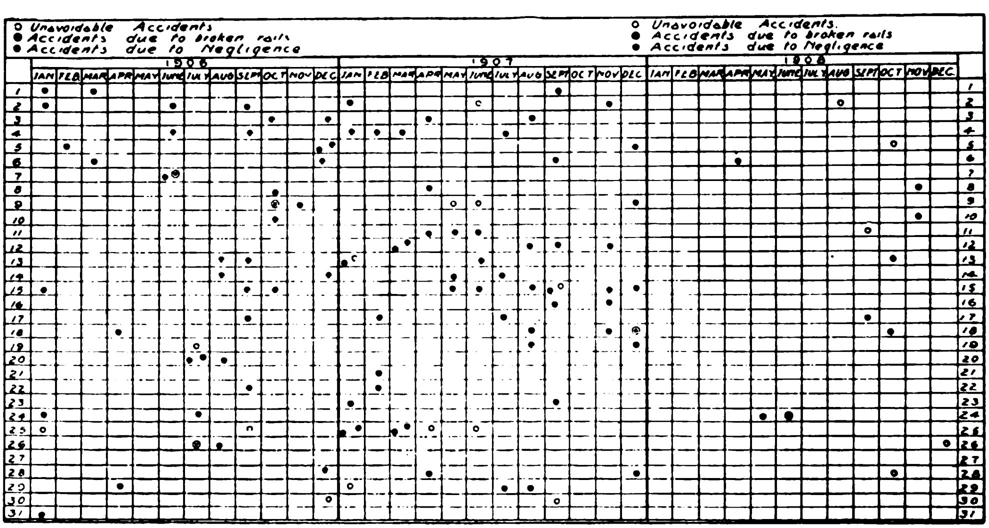


A RAILWAY'S RECORD OF ITS ACCIDENTS AND THEIR CAUSES.

The new plan of publicity for accidents was put into use in January, 1908. Note the radical change for the better in the record for that year as compared with the two previous ones. This sheet is from the Southern Pacific system.

but they turn the sunlight of publicity on them; they may almost be said to advertise them, with all their causes and consequences. They invite the public to come in and help them find out the true reason for accidents; post bulletins about them at division headquarters; and also send bulletins to the newspapers in the towns and cities along the lines with courteous requests that they be printed.

In the management of the Union Pacific and the Southern Pacific roads and their affiliated lines E. H. Harriman has two lieutenants of world wide reputations as railway experts. They are, Mr. Kruttschnitt, who, as already stated, is



AN ACCIDENT SHEET FROM THE UNION PACIFIC RAILWAY.

Note the extraordinary lessening of the number of accidents after the publicity policy went into effect in 1908. The grouping of accidents in both sheets on this page shows how accidents occur in clusters. The apparent difference in the accident record of the two roads is accounted for by the difference in mileage.

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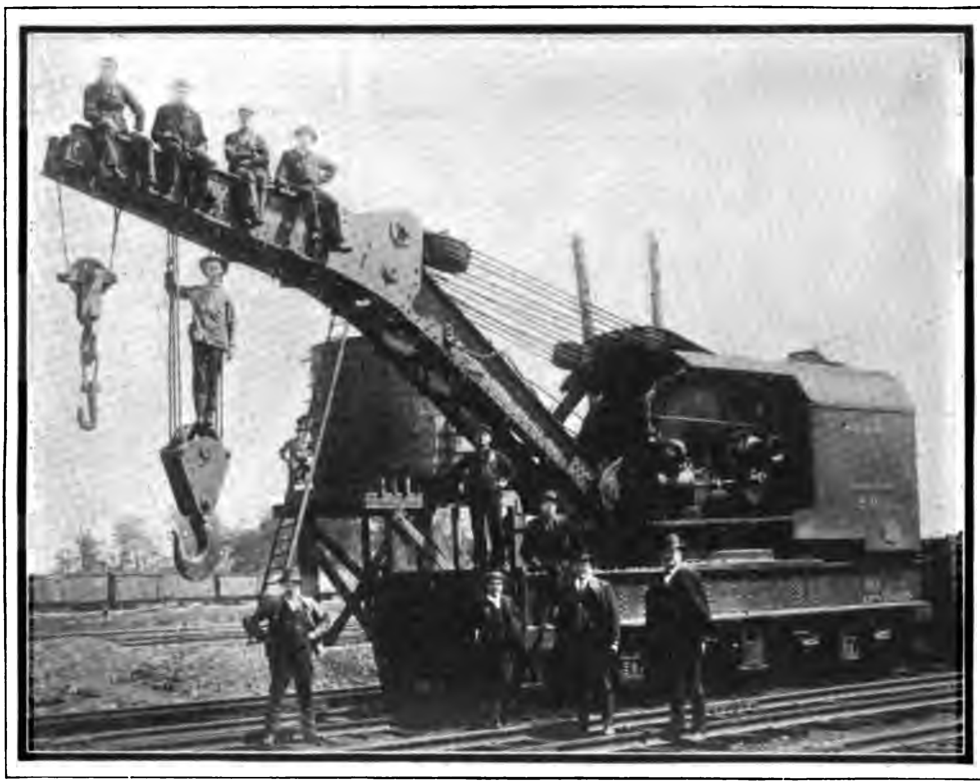
Director of Maintenance and Operation, and Mr. J. C. Stubbs, Traffic Director. The jurisdiction of each extends over the whole Harriman system. A railway is a factory of a sort. The construction, operation and maintenance department is the manufacturing department; it builds and keeps up the plant and makes transportation. The traffic department is the sales department; it sells transportation. As the head of the maintenance and operating—the manufacturing—department of the great Harriman system Mr. Kruttschnitt conceives that it is his principal duty to make and furnish to the public the best and safest transportation possible. A German by descent, an engineer by training, his motto seems to be "Thorough." Furnished by Mr. Harriman with ample funds, he has in a decade changed the Harriman lines from moribund properties into among the most efficient agencies of transportation in the world. "The greatest pleasure one can get," he says, "comes when he feels that he is doing a thing just about as well as it could be done." This is his philosophy of work. But Mr. Kruttschnitt is not merely a part of the very efficient machinery of the Harriman lines. He is a very human man with a heart as big in proportion as his fine head and stocky body. The two of his qualities referred to—his love of efficiency and his humanity—caused the adoption of the system of giving publicity to accidents.



A WRECKING CRANE—A MACHINE TOO OFTEN CALLED INTO SERVICE.

Accidents cost a railway a great deal of money, directly and indirectly; they are a sure symptom of inefficiency somewhere; this was enough to lead him to give much intense study to the subject. They kill and maim thousands of employes and travelers annually; human sympathy should by all means prompt railway operatives to spare neither effort

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ONLY MONEY, NOT LIVES, LOST THIS TIME.
Publicity is making such wrecks as this scarcer every month.

accident on our own lines. The matter harassed my mind all the time; thoughts of those we were injuring and killing would not let me sleep at nights."

Public opinion was operating at that time with great force to stop rebating and other bad practices that had prevailed in the railway business. It occurred to Mr. Kruttschnitt that if public opinion was a good remedy for other evils it might be a good remedy for accidents. If the fear of exposure would keep men from

nor money to reduce them to a minimum.

"I suppose," said Mr. Kruttschnitt, "that many people think railway officers get so used to fatal accidents that they make little impression on their minds. That is very far from true. Two years ago when all the roads in the country were having so many fatal wrecks, I got so I almost feared to read a telegram, lest it might bring news of some bad

soliciting and accepting rebates, why should not fear of exposure, if they caused wrecks, stimulate engineers, conductors, and telegraph operators, strictly to obey rules and orders? Why should not railway officers be impelled to make more thorough investigations of accidents, and to more courageously discipline those who caused them, if they knew the public was to be given the facts, and would back up those

THE RESULT OF A MISPLACED SWITCH.
Men who know they must face an informed and understanding public are more careful to avoid causing such wrecks.

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who did their duty and condemn those who did not do it?

When Mr. Kruttschnitt first outlined his novel plan to the officers of the various Harriman roads they were skeptical about it. One of his peculiarities as a railway executive is that he never issues a peremptory order for the adoption of a new method or device if he can avoid it. He prefers to explain his plan and then wait till the officers of some road or division get his point of view and grow really anxious to carry it out. The motive and the shrewdness of this are obvious; by getting his new methods tried by men who thoroughly understand and believe in them he gets them tried under the conditions most favorable to their success. This was his policy in regard to publicity for accidents. In February, 1907, the officials of the Union Pacific decided the scheme was worth trying. It produced such satisfactory results that a year later the officers of all the roads in the system secured its extension to their lines, where it has produced equally good results.

The method employed is simple. On every division of a railway there is a master mechanic, whose duty it is to keep the locomotives and cars in good condition; a division engineer whose duty it is to keep the track in good condition; and a superintendent, whose special duty it is to get trains over the road, but who is also the superior of the master mechanic and the division engineer. On every railway—or on big roads on every grand division—there are higher officers corresponding to the divisional officers, viz., a superintendent of motive power, a chief engineer, and a general superintendent. Still above all these officers on each of the Harriman lines is the vice-president and general manager who reports directly to Mr. Kruttschnitt.

WRECK ON A LOGGING RAILWAY, PACIFIC NORTHWEST.
Due to a miscalculation, for which the blame was placed on the right man.

Under the new system when an accident occurs that causes a considerable destruction of property, or any loss of life, the superintendent, engineer and master mechanic of the division are required to go at once to the spot and organize a "board of inquiry," composed of themselves and two or more citizens of the community. This board makes a thorough investigation; examining the scene of the accident, the track, the engines, the cars, and taking the testimony of trainmen, track-walkers, citizens and everybody else who may be able to throw any light on the subject.

Mr. Kruttschnitt enforces inflexibly the rule that the cause of the accident must be ascertained. If the divisional board of inquiry reports that it cannot find the cause it is often sent back to

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CURIOUS WRECK IN WHICH NO ONE WAS HURT.
This fact, however, cannot wipe out the blame of the guilty.

work quickly. It prepares a report of its findings, stating the nature of the accident, its results to property and persons, the cause or causes, the names of those to blame and the discipline to be inflicted. A bulletin is furnished promptly to the local newspapers, and is posted at the division headquarters of the road.

To get at the facts is seldom an easy matter. Everybody has an inclination—a perfectly natural and often unconscious tendency—to try to shift the blame on somebody else. A freight train on a certain road had gone into a ditch. "What's the matter, Murphy?" the division superintendent on his arrival asked the conductor. "A broken flange on a freight car," answered Conductor Murphy. "Have you found one?" "Yes," was the reply, "and if I hadn't I'd have d—— soon broken one." This actual incident illustrates the nature of the obstacles that often are put in the way of getting at the truth. "There never was a truer saying," says W. L. Park, General Superintendent of the Union Pacific, "or a greater reflection on railroad men than that 'the science of railroading is the art of shifting responsibility.' From the track to the tender, from the engine to the coal, from the dispatcher to the conductor, from the trainmaster to the call boy, from one department to another, and so on *ad infinitum.*"

How thorough the investigations on the Harriman lines are is illustrated by one that was made regarding a wreck which occurred at Borie, Wyoming, on the Union Pacific on November 10, 1908. A freight train collided with a work train, and ten employes were killed and two injured. A board of inquiry com-

make another investigation. If it fail again, a second board of inquiry, composed of the general superintendent, the general superintendent of motive power and the engineer of maintenance of way and two or more citizens of the community is formed and makes another investigation. If this board reports that it cannot fathom the cause, it is reorganized with the general manager presiding, and still another investigation is made. In only one instance within the more than ten years since Mr. Kruttschnitt became Vice-President of the Southern Pacific has an accident happened in his jurisdiction the cause of which sooner or later has not been learned, and this one took place before the present method of investigation was adopted.

The board of inquiry usually does its

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posed of the division officers and two local bankers fixed the blame for the accident on the conductor and brakeman of the freight train and recommended their dismissal from the service. This finding not being satisfactory to the management another board of inquiry was convened, composed of George M. Randall, a retired Major-General of the United States army; Frank D. Baldwin, a retired Brigadier-General of the United States army; Charles C. Hughes, a retired General Superintendent of the Chicago & Northwestern; W. B. Scott, Assistant Director of Maintenance and Operation of the Harriman System; A. L. Mohler, Vice-President and General Manager of the Union Pacific; W. L. Park, General Superintendent of the Union Pacific; H. H. Forney, General Air Brake Inspector of the Southern Pacific. This board found that beyond reasonable doubt the man who primarily was to blame was the engineer of the freight train, who by improperly manipulating the air brakes had lost control of his train on a steep grade. Had the train crew responded promptly to calls for hand brakes the accident could have been prevented.

The facts often are hard to get at owing to latent defects in track or equipment. On one occasion the derailment of a passenger train caused a bad wreck. The division engineer reported the track in good condition; the master mechanic said there was nothing wrong with the cars or engine. Two boards of inquiry failed to find out the cause of the accident. But the management insisted there must have been something wrong somewhere or there would have been no wreck. Finally, a locomotive was run over the track where the accident happened. At one point a rail was observed to sink. The track was torn up, and under the rail was found buried an old decayed box culvert, which sank enough when the train was on it to cause the derailment, but sprang up again when the train had passed.

PICKING UP PULLMAN SLEEPERS FROM A RIVER BED.
The track walker who misses a broken rail finds the comments of his home friends his bitterest punishment.

About 150 of these boards of inquiry have been convened; and they have included men from every walk in life—

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THE KIND OF COSTLY WRECK THAT PUBLICITY IS CURING.

regular army officers, bankers, farmers, hotel proprietors, newspaper men, doctors, lawyers, etc. John R. Osborne, former Governor of, and former Congressman from, Wyoming, sat on a board that recently investigated an accident due to a boiler explosion. A special effort is made to get newspaper men to serve, both because of their unrivaled means of giving publicity to the facts, and because when it is known they do know the facts they can have no good excuse for misstating them.

The new system has produced marked effects on officers and employes. The locomotive engineer knows that if he runs past a signal set against him and a fatal accident results every one will be told who was to blame. The roadmaster knows that if a defect in his track ditches a train, nothing can save his fault from publicity and public condemnation. Many men who can bear the censures of their superiors cannot stand the thought of having the results of their careless or reckless disobedience of rules published in their local newspapers and read and discussed by their families, fellow employes and neighbors.

It sometimes has been asked what good it can do to have merchants, farmers, druggists or newspaper men on boards of inquiry to investigate railroad accidents. The experience of the Harriman lines has shown that it may do a great deal of good. A newspaper man or a banker will not learn much by looking at a broken rail or a bad sheet in a boiler that has exploded; but he can see and tell his neighbors whether the railroad experts make a thorough or a "whitewashing" investigation, and his presence animates the railroad experts to do their work conscientiously and thoroughly.

There has been a marked reduction in the number of serious accidents on the Harriman roads since 1907, when they began to take the public into their confidence. Traffic, meantime, owing to the depression in business, has been somewhat lighter than it was before the new plan was adopted; and accidents always rise and fall with traffic. But the reduction in accidents has been much greater in proportion than the reduction in traffic. How great the reduction in accidents has been is shown on page 512 by the "fly-speck charts," as Mr. Kruttschnitt dryly calls them. The great number of accidents on the Southern Pacific is, of course, due to its 9,000 miles, the largest mileage of any railway in the United States.

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These charts disclose one very interesting fact besides the rapid decline in accidents that has taken place. It has long been a saying among railway men that accidents always come in groups of three. Persons of skeptical minds have scouted this. Persons who have believed it have speculated about its occult cause. The charts show that while the "three accidents" theory is not exactly correct, there is a very substantial basis for it; that there is a strong tendency on each road after a period of a few days free from accidents, for two, three or more accidents to occur almost simultaneously or in quick succession. Mr. Kruttschnitt explains this by a theory that is not at all occult. A vast majority of accidents is due to the human element—to failure of somebody to obey or enforce orders or rules. When nothing has gone wrong for awhile there is a natural tendency—railway officers and employes being human beings—for everybody on a road simultaneously to grow just a little careless. Result: a series of accidents. The news spreads quickly; everybody braces up; and there is a period free from accidents. Then everybody relaxes just a little; and there is another batch of accidents. The bearing of this on "publicity for accidents" is obvious; the quicker the news and cause of a wreck are sent widespread the sooner will everybody brace up and the less likelihood will there be of a bad series of wrecks. The tendency of accidents to come in bunches is illustrated by the record of the Southern Pacific in August, 1907. In that month there were twenty-seven accidents on this road. On two consecutive days there were seven accidents; on each of seven non-consecutive days there were two to four; and on fifteen days of the month there was not a single accident to record.

Railway casualties have been for many years a subject of constant newspaper exaggeration and misrepresentation. Newspaper men have said that they would gladly tell the truth if they could get it—that the fact that they did not print it was entirely due to the foolish and vicious policy of the roads in trying systematically to suppress information to which the public was entitled. The experience of the Harriman lines tends to vindicate this view. The newspapers are now printing almost nothing but the truth about wrecks on these roads. At Oakland, California, on July 14, 1908, the engineer of a Southern Pacific passenger train in broad daylight ran past a signal that was plainly set against him, and his train, in consequence, was cut in two by a train on a crossing track, and seven people were killed and nineteen injured. A board of inquiry composed of eleven railway officers and four citizens was promptly formed, and the facts were speedily ascertained and given to the press. Formerly there would have been suppression of facts, publication of false reports and denunciation of the railway management; now the newspapers printed nothing but the truth, and put the blame where it belonged.

Public opinion has been influenced favorably to the roads by the changed attitude of the press. It has been similarly influenced by the presence of citizens on the boards of inquiry. They tell their neighbors about the way the investigations are made. They learn to how large an extent accidents are due to violations of rules by employes, and defend the justice of discipline, the need for which they have brought forcibly home to them.

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FIGHTING FOG WITH HERTZIAN WAVES

By EDFRID A. BINGHAM and JOHN PARSLOW

FOG, the chief cause of maritime disasters, a frequent cause of railway accidents, and the bane of life in many industrial cities, has met a conquerer at last. This is M. M. Dibos, a French engineer, who has invented a process by which the thickest fog can be dispelled over a given zone.

M. Dibos holds a prominent position as consulting engineer of La Foncière-Transports, the leading French maritime insurance company, and in that capacity is constantly called upon to investigate the cause of wrecks and to advise measures for their prevention. During his long professional experience he became impressed with the gigantic importance of fog as a factor in maritime disaster and delay. Not only is fog responsible for the majority of collisions in the open sea, many attended by great loss of life, but it also determines the greater number of casualties to vessels entering or leaving harbor. The suppression of harbor fog will render services of incalculable value to humanity.

A Clear Day—No Fog.
Where the experiments were carried on, near Boulogne.

On land everybody is familiar with the direful effects of fog in connection with railways. By shrouding the signals, fog has caused many an engine driver to dash his train to destruction and his passengers to a death the very thought of which freezes the blood of nervous travelers. By dispelling fog in the vicinity of signals it may be possible to reduce railway disasters to a minimum—at any rate to help lessen their number.

The misdeeds of fog in certain industrial districts have long been a subject of scientific study. In some "black countries" fog prevails almost permanently, and the inhabitants consequently live in a semi-darkness which is not only unpleasant but also unhealthy. Fog impedes the action of health-giving sunlight, particularly of the violet and ultra-violet solar rays that possess the power of destroying disease germs. These rays are absorbed by fog, and cannot exercise their antiseptic action in a foggy region.

Since 1898 M. Dibos has devoted attention to the dispelment of fog with the aid of Hertzian waves in combination with intense heat-waves produced by the admixture of oxygen and hydrogen. His discoveries in connection with Hertzian waves have been already recognized by awards from the Smithsonian Institution, the French Academy of Sciences and the French Society of Civil Engineers, of which he is one of the leading lights.

M. Dibos based the tactics of his campaign against fog on Aitkin's theory respecting fog and on Lord Kelvin's investigations. Aitkin considers that fog results from the condensation of tiny drops of water around minute particles of dust, particles so minute that they remain suspended in the air. Lord Kelvin has shown how such condensation of tiny drops of water occurs on the sides of the recipients used in laboratory experiments. Aitken has pointed out

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The Hertzian Waves Dispelling the Fog.

that the minute particles of matter suspended in the air form a nucleus for the creation of fog-spots, and says that if these suspended particles did not exist in the air there would be no fog and no clouds. All the excess of aqueous vapors over-saturating the air would fall to the surface of the earth in the form of dew.

The fact that fog is caused by the agglomeration of aqueous vapors around particles of dust explains why fogs are so prevalent in manufacturing districts. The factories emit dense columns of smoke filled with dust particles which accumulate in the atmosphere and form permanent condensation-stations for the aqueous vapors in the air, thus condemning those districts to be perpetually under the reign of King Fog.

It is natural that the sea should be a great producer of fog, as the winds carry particles of various organic and mineral dusts to immense distances from shore.

The practical problem M. Dibos had to face in his fight against fog was to clear the air of the dust-particles forming the nuclei of the fog-spots. The fog-spots hold together in a cohesion that might be compared to that of a honeycomb. If that cohesion and the resulting equilibrium could be destroyed, the dust particles would descend and the condensed water would return to the condition of transparent vapor.

One of M. Dibos' ideas for the dispersion of fog was obtained from an observation he made on a Channel steamer on a foggy day. He noticed that in the trail of the air-shaft from the stoke-room there was a slight diminution of fog extending to some distance. The hot air had dispelled the fog in a line about thirty yards in length. This suggested to him the utilization of hot gases, which he now employs successfully in conjunction with Hertzian waves, the function of these waves being to jar and displace the dust particles, as a stone thrown into a pool sets in motion the water. The tendency of the disturbed dust particles is downward, and as they strike one another their action, aided by the heat, is cumulative in falling toward the earth.

Some time ago M. Dibos invited a small number of scientists and engineers to the Gare du Nord, one of the principal railroad stations in Paris, on a foggy day. He there created a sensation by completely dispelling a dense fog in a zone around the signal points, whereas the line beyond the zone was wrapped in fog of the densest kind.

M. Dibos has effected his latest achievements at Wimereux, close to Boulogne. Over the Villa Excelsior he has raised a mast such as is customarily employed in the process of wireless

When the Waves Cease the Fog Once More Descends.

telegraphy. At the top of the mast he has placed a circular antenna with diffusing points made of copper. With this diffuser he emits Hertzian waves, by secondary current, of a power varying from 380,000 volts to 400,000 volts. Slightly below the Hertzian-wave emit-

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ter is a smaller metal circle supporting the nozzles of four blow-pipes for the emission of hot gases derived from the admixture of oxygen and hydrogen. The apertures of these blow-pipes are directed toward the four cardinal points,

Maurice Dibos.
Inventor of the scheme for dispersing fog with the aid of Hertzian waves.

and from each is emitted a heat-wave of 2,000 degrees centigrade. Rubber tubes connect the apertures with the collector where the admixture of gases is effected. An apparatus the exact nature of which is kept secret for the present controls the emission of the Hertzian waves in connection with the heat waves —a combination which in the opinion of M. Dibos produces the ions that dispel the fog. This controlling apparatus occupies only a small space, and M. Dibos can easily carry it to any point where it is necessary to dispel fog.

Recently during a thick fog M. Dibos dispelled the gloom around the villa over a zone exceeding 200 yards in extent. This zone was maintained free from fog during two hours. When he ceased the emission of his combination of Hertzian waves and heat waves the fog gradually descended again. But while the apparatus was in operation there was an area of more than 200 yards of clear, clean air, whereas outside the zone it was impossible to see more than one or two yards ahead owing to the density of the fog.

Photographs of the villa have been taken in clear weather, others while the Dibos apparatus was dispelling the fog, and still others while the fog was descending again after the working of the apparatus had ceased. A comparison of the two latter is especially interesting as showing how the apparatus forces the fog down to the ground. When the apparatus is set in motion a fog-free space soon becomes noticeable above the station. This gradually extends until an observer standing at some distance from the villa is able to see the roof, the upper story and ultimately the details of the façade and the fence surrounding the house.

Before utilizing his circular antenna for Hertzian waves M. Dibos employed an antenna provided with a rake-shaped emitter and placed about 33 feet above the villa, which is 95 feet above the sea-level. The electric tension attained at the extremity of the antenna was 140,000 volts, whereas, as mentioned above, M. Dibos now obtains 400,000 volts. With the primary apparatus a fog-free zone of from 110 to 130 yards was obtained. The newer method gives a clear zone of 200 yards, and it is understood that M. Dibos is now able to extend it to 300 yards. The apparatus for the admixture of the heat-producing gases remains the same, and is of the autogenous type.

In his quiet office M. Dibos was found surrounded with models of various inventions which have made his name famous in the technical and engineering worlds. One of these inventions is a diver's helmet provided with a complete telephonic apparatus, which has been adopted by the French navy. On the table were designs for the new system of building tank steamers, a system M. Dibos has devised with a view to obviating the many fatal accidents that are at present associated with the transport

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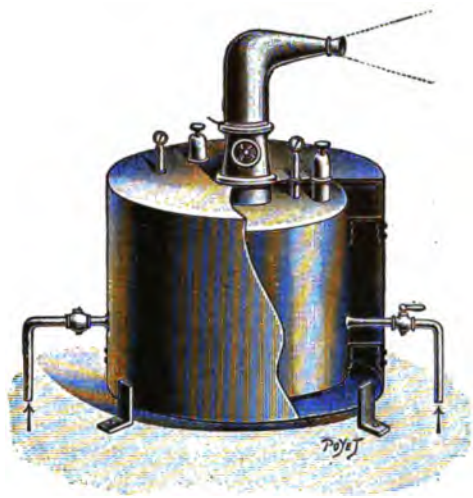
of petroleum and such hazardous products. M. Dibos is a man in the prime of life, possessed of true Gallic urbanity and courtesy, and he speaks English fluently.

In connection with the success of his process for dispelling fog, M. Dibos expressed his belief in the unbounded potentialities of Hertzian waves. He recalled the successful application of these waves to photo-telegraphy, and declared his conviction that within a comparatively short time the utilization of Hertzian waves will enable us not only to telephone without wires but at the same time to have before us a portrait of the person with whom we are conversing. He endorses also Dr. Le Bon's conviction that Hertzian waves can be employed to explode torpedoes and even to penetrate the magazines of warships —a contingency which would render naval warfare impossible.

In regard to this fog-dispeller M. Dibos said: "By my process it is possible to clear of fog an area sufficiently large to enable a vessel to enter port in foggy weather. Fog-dispelling stations can be placed at intervals along the quays in such manner that when the vessel leaves the zone cleared of fog by one station it enters the zone cleared by the succeeding station. When it is desired to clear a channel more than 300 yards wide it will be necessary only to install stations on both sides of the channel in such way as to enable incoming and outgoing steamers to advance without difficulty or danger.



Apparatus Used by M. Dibos in Dispelling Fog.

"I anticipate also that my system will do much to diminish the dangers of railway travel. It is not necessary to have continuous stations all along the line. It will be quite sufficient to place fog-dispelling stations at the signal points. These will enable engine-drivers to see whether the signals are against them or not, and thus free them from doubt and error."

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WHO OWNS THE EARTH?

VII. THE AGE OF IRON

By HENRY M. HYDE

THIS is the age of iron. And the story of iron is the most wonderful, the most fantastic, the most romantic story in the world. The dull red ore, dug out of the earth, has changed the whole course of civilization. It has linked the far corners of the earth together; raised a thousand towers higher than that of Babel; turned the oceans into mill-ponds; changed ten thousand dirty-faced, bare-footed boys into multi-millionaires and created—as its own monument—vastly the greatest and most powerful corporation in the world.

The influence of the United States Steel Corporation is felt around the world. Its decisions and its policies affect and sometimes determine the course of nations. It deals in figures so vast that, to the average man, they are incomprehensible. Its annual report of income and expenditure reads like the budget of a great government. Its managers wield a power greater and more despotic than that of most kings.

THE LAKE TRAFFIC IN IRON ORE.
Automatic machinery unloading a vessel.

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All the greatness and power of the Steel Corporation is fundamentally based on its ownership and control of one of the great natural resources of the country — iron ore. On these vast beds of ore—originally acquired from the government for little or nothing—the promoters of the steel trust have built up a tremendous financial monster, with a total capitalization of a billion dollars, while the people, to whom all the iron-beds originally belonged, having ignorantly and stupidly allowed themselves to be despoiled of their birthright, are now taxed to pay dividends upon millions of securities which are based on the value of these ore beds.

FURNACES OF UNITED STATES STEEL CORPORATION, AT GARY, IND. It is planned eventually to make more steel here than at any other point in the world.

Iron ore is one of the natural resources of which the possible supply is fixed and limited. Once the ore beds are exhausted they can never be replaced. Consequently a corporation which controls a great reserve supply of ore must find its property constantly growing more and more valuable. It can safely capitalize and pay dividends on not only present but future values.

In Canada and other countries where the people are awake and alert the national government no longer permits or allows its unoccupied ore lands to be grabbed up by shrewd and more or less unscrupulous business men. It refuses to sell them at any price or on any terms. But—that progress may go on unchecked—it is glad to lease such lands on a royalty basis, a fixed sum of money going into the public treasury for every ton of ore taken from the public domain. In this way the natural resources are used as they should be and the heritage of the whole people is made to pay a dividend for the public benefit.

That such an arrangement would not be impossible; that such shrewd men as the directors of the steel trust would be glad to make it, is shown by the fact that they recently signed exactly such a contract with James J. Hill and other stockholders of the Great Northern Railroad, whereby they bound themselves to pay an average of a dollar a ton for 600,000,000 tons of ore, to be dug from land which a few years ago was an unregarded part of the public domain and which cost the Hill party little or nothing. The proceeds of that single contract would pay for building two canals across Panama.

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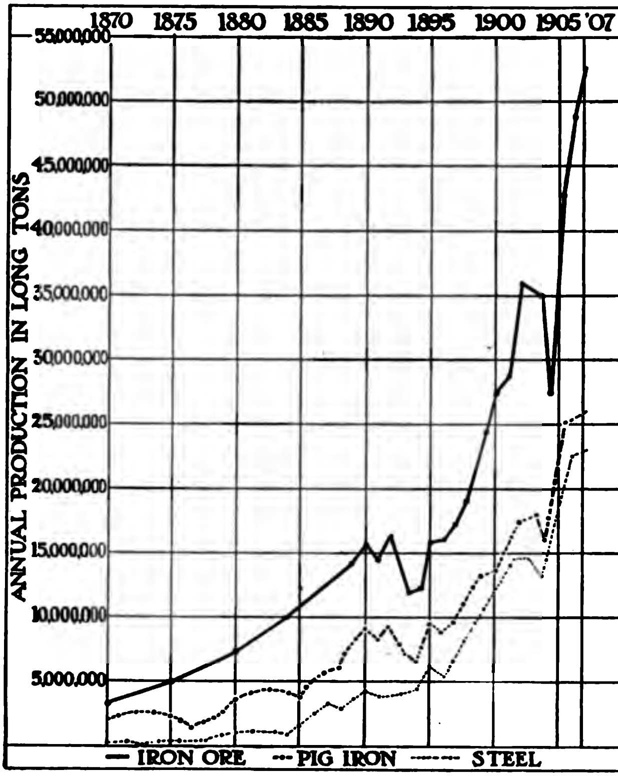

A TABLE THAT TELLS A STORY.
Increase of production of iron ore, pig iron, and steel between the years 1870 and 1907.

Holding in its hands the deposits of iron ore which are the richest and the most easily mined, the Steel Corporation is in a position to acquire, on the most favorable terms, ore beds which are less rich and harder to work, but which must soon be drawn on if the present rapidly increasing consumption of iron and steel is to continue.

Just before the recent panic a majority of the stock of the Tennessee Coal and Iron Company was deposited as collateral with a large New York bank. When the financial cyclone struck Wall Street it became necessary for the bank in question to immediately turn its huge holdings of stock into cash—else ruin was certain. The failure of this bank, on top of the other disasters which had already appalled the public, would almost certainly have precipitated a financial cataclysm. But, while the panic-feeling was in the air, it was almost impossible to find a purchaser for these great stock holdings.

For a time the failure of the bank seemed inevitable, but, presently, with the consent of the Roosevelt administration, the United States Steel Corporation stepped into the breach and bought, in one lump, the control of the Tennessee Coal and Iron Company, paying a little less than $50,000,000 for its bargain.

It was pointed out at the time that in making this purchase the steel corporation had played the part of a patriot. Doubtless it did save the bank and to that extent helped to prevent the panic from becoming a rout. But a moment's glance at what the steel trust got for its fifty millions will convince any one that, all patriotic purpose aside, the purchase was magnificently profitable. Leave out of consideration the blast furnaces and steel mills in running order, and the huge coal fields which were a part of the property of the Tennessee Company, and consider only the deposits of iron ore which it owned. On the authority of people high in the confidence of the trust, it is stated that these ore deposits include more than 700,000,000 tons. At a price of only fifteen cents a ton they represent an actual value of more than $100,000,000, or twice the price paid for all the property of the Company.

Primarily—as has been stated—the supremacy of the United States Steel Corporation depends upon its ownership and control of great deposits of high grade iron ore. Valuable as are the ore beds in the South, which it acquired by the purchase of the Tennessee Coal and Iron Company, they shrink into insignificance when compared with its enormous holdings in the Lake Superior district. From the books of the steel trust itself, has been compiled a statement showing that in the Marquette, Menominee, Gogebic, Vermillion and Baraboo districts, the

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steel corporation has in sight 1,200,000,000 tons of high grade ore. Nor does this include the large deposits in the same region which it controls under its contract of purchase with the Great Northern Railroad Company.

The Lake Superior region deposits, where the steel corporation is dominant, are unquestionably the largest of very high grade ore, as well as much the easiest and cheapest to work. In many parts of the Lake Superior region the ore outcrops at the very surface of the ground and can be shoveled into the cars like so much earth. These ores average more than fifty per cent iron and are very easily smelted. They are a much higher grade than the southern ores obtained through the purchase of the Tennessee Company, and are conservatively valued at sixty cents a ton, making a total worth of more than $700,000,000—a very fair start towards the billion dollar capitalization of the steel trust.

That the figure of sixty cents a ton is a conservative one may be judged by the fact that the steel trust was very glad to make a contract with the Great Northern Railroad Company, to mine the ore from the beds which it owned, paying—for the first year—eighty-five cents a ton—with a rise each succeeding year of three and four-tenths cents a ton.

From these ore beds the stockholders of the Great Northern Railroad Company will eventually garner riches greater than were ever dreamed of before the exploitation of the natural resources of a country began on a wholesale scale. The Great Northern mines lie in the Mesaba County of Minnesota. They were picked up at ridiculously small prices paid out of the surplus earnings of the railroad company, secured from land grants and other inexpensive ways and—if the estimate of 600,000,000 tons is correct, they will return the lucky holders of certificates more than $600,000,000—all profit created out of nothing by the magic of one man's financial genius and by the pitiable laxity of a people which thus allows the inheritance of the many to be devoted to the enrichment of the few.

A MOUNTAIN OF IRON ORE.
The raw material ready for the smelter.

Contrary to the general impression, the deposits of iron ore in the United

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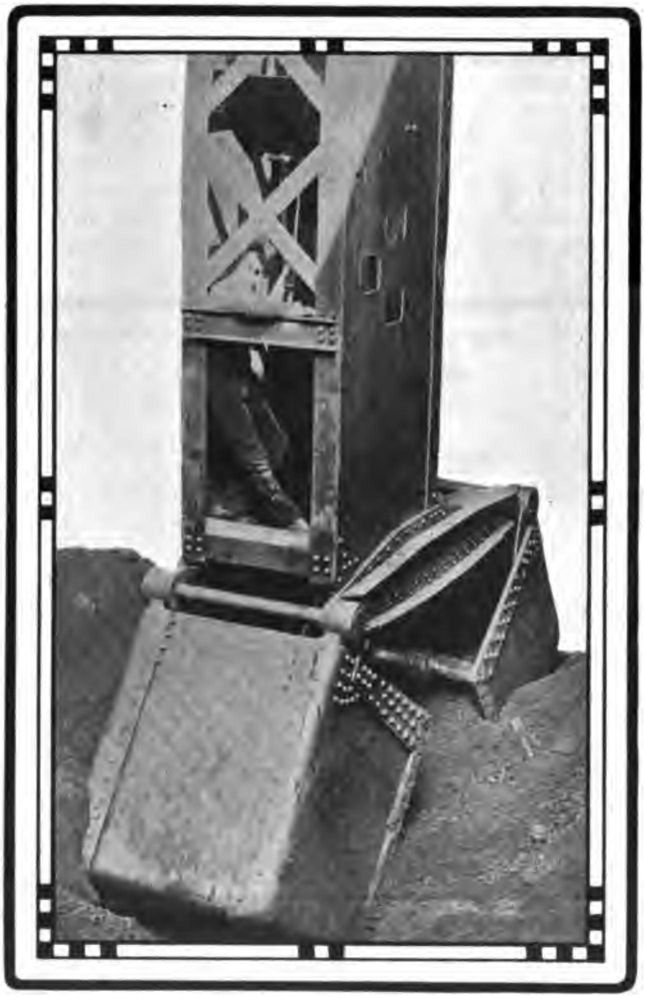
States are not large as compared with those of other countries. Estimates of the supply available vary widely and must always be subject to revision, as heretofore unknown beds of ore are discovered or new methods of smelting, make lower grade ores available.



Clam Shell Bucket for Automatic Unloading of Iron Ore.

A few years ago a Swedish expert made an estimate for his government of the world's supply of iron ore. His figures are as follows:

United States	1,100,000,000 tons
Great Britain	1,000,000.000 tons
Germany	2,200,000,000 tons
Spain	500,000,000 tons
Russia	1,500,000,000 tons
France	1.500,000,000 tons
Sweden	1,000,000,000 tons

This makes a total supply for the whole world of only 9,000,000,000 tons. Of this the United States is given credit for little more than one-ninth, while at the same time it is consuming at least one-third of all the ore dug, yearly. According to this estimate the world's iron ore would be entirely exhausted in 1960.

In the opinion of American experts the supply of iron ore in the United States is vastly greater. President Charles S. Howe, of the Case School of Applied Science, for instance, estimates that there are one and one-half billion tons still unmined in the Lake Superior district, two and one-half billion tons in the southern district, and probably five billion tons of various grades of ore lying elsewhere in the territory of the United States, making a total domestic supply of nine billion tons. But as President Howe points out, at the present increasing rate of consumption the production of the Lake Superior ore beds will be exhausted in 1940, and, by the end of the present century all the ores will be gone which are of a grade high enough to be worked at the present time. The late Professor Shaler, one of the greatest experts who ever lived, estimated that all the iron ore in the United States would be used up within the next hundred years. That these are not the views solely of theoretical alarmists is shown by the opinion held and expressed by Charles M. Schwab, late president of the steel corporation, and certainly one of the most practical of men. Mr. Schwab is firm in his conviction that the iron ores in the United States will be exhausted within the next sixty years.

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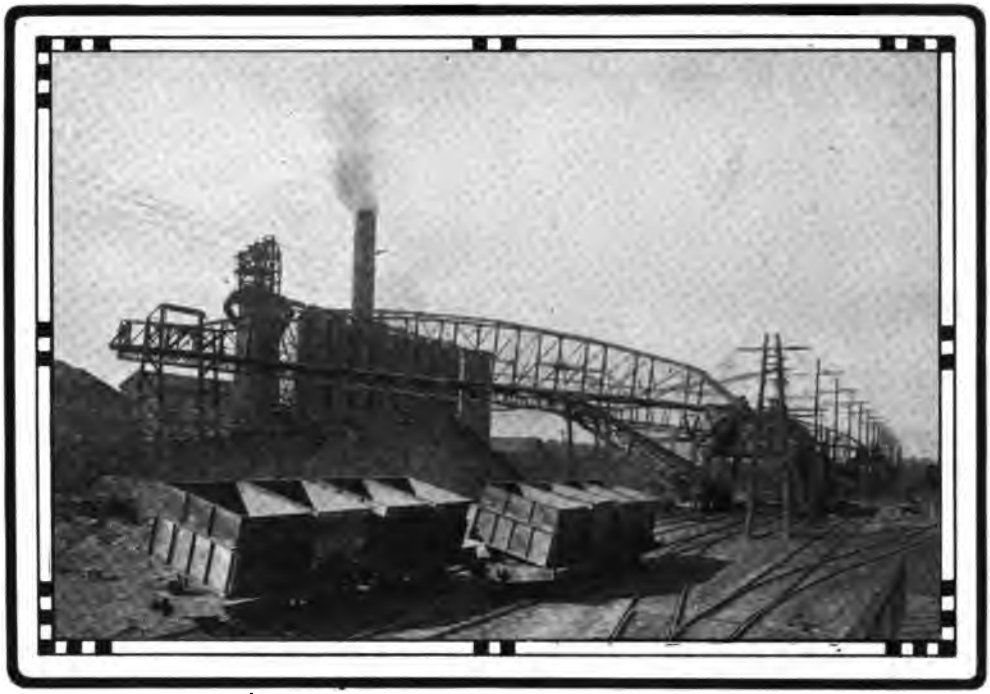

ORE HANDLING APPARATUS AT BLAST FURNACE.

From our present view point the exhaustion of the iron ores of the United States would be a tremendous national calamity. But there are certain facts and certain probabilities which must be taken into consideration in attempting to form a just idea of that far distant situation. In the first place there is no doubt that electric smelting furnaces and magnetic processes of separation will be perfected which will make available enormous quantities of ore, so poor in grade that they are at present entirely neglected. Again it is fair to presume that other materials will be found which will take the place, to a considerable extent, of iron and steel as they are at present used. Within the last few years, for instance, cement has come largely into use, doing the work, to a considerable extent, of both timber and steel. It may also be expected that the development of water transportation all over the country will save great quantities of steel now used in railroad tracks and equipment.

It is also certain that before its supply is entirely exhausted, the United States will be importing great quantities of iron ore from Spain and other countries which do not possess its coal deposits and the other facilities for working the ore. In Canada to the north and Mexico to the south it may be expected that great deposits of iron ore will be discovered from which the United States will be able to draw a considerable supply. Under the present law there is a duty of forty cents a ton on iron ore imported into the United States. At the time of writing, Congress being still in session, the House of Representatives has reported a tariff bill putting iron ore on the free list, while the Senate seems determined that a tariff somewhat smaller than that at present in force, shall be continued. It would seem to be in the interest of the whole people that no duty or other artificial bar should be put in the way of bringing in as much foreign ore as possible, to supplement our own rapidly diminishing supply.

At any rate man's ingenuity may be trusted to find some available substitute when all the present stock of iron ore is exhausted. Certainly a considerable number of steel mills will be able to run

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indefinitely, using only the scrap iron which will come to them in the shape of "junk." In 1907 for instance, more than twelve and one-half million tons went to these steel mills in the shape of "junk," the total price paid by the mills amounting to nearly $150,000,000. In this way the iron and steel may be worked over and over again as it wears out in one position, and be made available for use in another.

In the meantime the stockholders of the steel corporation, reaping the incredible profits which are based on their control of a great natural resource, will watch, with shrewd and far seeing eyes, for the time to unload their holdings on people less well informed. They themselves will doubtless invest their capital in the control of other natural resources as yet largely undeveloped. Already—as has been pointed out in this magazine—men who have grown vastly rich out of their holdings in oil, iron and land are busy buying up water-power sites, preparing for themselves and their descendants a permanent and perpetual monopoly in one of the greatest and most important of all the natural resources that remain to us.

TEN YEARS OF PATIENCE

By LEN G. SHAW

FOR more than ten years there has been in progress at Detroit, Mich., a struggle unique in engineering annals, with the end still far distant. With dogged determination those back of the undertaking have fought Nature on her own grounds, have no less than a half dozen times turned seeming defeat into victory, and in the face of overwhelming odds have pushed steadily onward toward the goal until now success is almost within their grasp.

In the spring of 1898 E. F. Bradt, a mining engineer of wide experience; J. M. Mulkey, long identified with the table salt industry, and A. E. Jennings, an insurance man, conceived the idea of sinking a shaft into the rich salt deposits that lay 1,000 feet below the surface to the westward of the city. A contract was accordingly let for the work to a man who at the time was engaged in completing the wheel pits for a power plant at Niagara Falls, an undertaking beside which the sinking of a shaft like this seemed trivial.

It was provided that the promoters of the salt mine should drill a test well adjoining the site of the shaft, the borings therefrom to serve as a guide for the contractor. One hundred and eighty-five feet below the surface the six-inch bit in the test well penetrated a flow of sulphur water that filled the hole. Forty feet further down another sulphur sea was encountered. This time the flow not only filled the hole but threw 500 gallons of water twenty-five feet into the air every minute. The contractor threw up the job on the spot, declaring that there was not the man living who could overcome such a flow. Two additional wells were sunk, with no better results, even the fourth attempt proving as disastrous. Then the project was abandoned.

Bradt was miffed. It was the first time in a long and varied career that he had ever faced defeat, and he set about encompassing the downfall of Nature, which had so successfully resisted the attempts to reach her hidden wealth. He had noticed that the flow of water brought with it large quantities of soft, porous limestone, indicating the presence of similar deposits through which the water was forcing its way. If the pores of the limestone could be plugged, he argued, there was no reason why the spot could not be passed in safety.

Taking a heavy beer keg so reinforced as to withstand an enormous internal pressure, he filled it with particles of

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HEAD OF SHAFT WHERE A TEN YEARS' WAR FOR SALT HAS BEEN WAGED.

limestone similar to that brought up by the sulphurous flow. One end of the keg was provided with a high-pressure water pipe, to correspond with the underground stream. In the other end of the keg Bradt inserted a second section of pipe, to which was connected a high pressure plumber's pump. Through this latter a thin solution of Portland cement was forced into the keg, combating the flow from the water main. After a time the pressure from the plumber's pump was reduced, it having become evident that the cement had penetrated the limestone, while the pressure from the water main was continued. After a short interval the water was turned off, the hoops on the keg removed, the staves knocked loose, and what had been a mass of porous limestone was found to be solid concrete. The experiment was an unqualified success, demonstrating Mr. Bradt's ability to shut off any flow of water in this manner.

Once more the work of sinking a shaft was taken up, the Bradt process having been patented in the meantime. A contract was let for a shaft six by sixteen feet and 900 feet in depth, this being in turn sublet to a Duluth concern, which followed the customary methods of shaft-driving and timber bracing. Silt and quicksand were encountered in great quantities before the work had progressed far, and one day the bottom surface of the shaft began to be forced upward by the weight of the earth surrounding it. Strong timbers were splintered before the inrush of silt and sand as though they had been straws, and in a few minutes the shaft that it had taken months to sink was a hopeless wreck. Again the contract was abandoned, and once more defeat stared the promoters in the face.

After slight delay a new construction company was formed, a different method being employed. This consisted of a bell-shaped perpendicular shield of heavy timbers, built to fit the dimensions of the shaft. Along the lower edge of this shield a steel knife extended down about six inches. Inside this shield the men worked in safety, its weight carrying it down as fast as the dirt could be loosened and taken to the surface.

Whenever rock was encountered, which was the greater part of the time,

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PLANT OF SALT COMPANY AT DETROIT. WHOSE LONG EFFORTS TO SECURE SALT ARE NEARLY CROWNED WITH SUCCESS.

pneumatic drills were employed, perforating the rock in V-shape, the rock being loosened by dynamite blasts.

When the rock excavation was begun a system of keeping the depths below thoroughly tested was inaugurated. A two and a half inch pipe was inserted in a hole in the rock, and inside this a drill was kept going thirty feet below the level where the workmen were toiling. If a flow of water was encountered, the drill could be removed, and a cap of sufficient strength to withstand any pressure clamped on the end of the pipe.

At the 152-foot level water shot up to a height of several feet. Then the cap was applied to keep the shaft dry, 260 shallow holes drilled at various angles into the rock of the shaft floor, and into these a solution of cement was forced, something over 600 barrels being used. After a time the cap on the test hole was removed and no water came forth, showing that the area to be drilled as well as for a considerable distance on each side had been securely plugged, leaving a concrete lining to the shaft after the core had been removed.

Tests continued in this manner until the 193-foot level was reached, when the test well on one side of the shaft showing no danger, the experiment was dispensed with on the other. Suddenly the drill penetrated a twelve-inch crevice, and with a roar the water burst forth. Two inexperienced men clambered up the ladder to the surface, pausing not in the order of their going. The other two, who were seasoned miners, attempted to check the torrent, striving to thrust the emergency pipe into the aperture. When the flood reached their armpits they gave up the task and climbed to the surface. Four hours later the shaft was filled with water, which was flowing over the top and off across the fields in a good sized stream.

There was but one thing to do, if this temporary repulse was to be overcome. The hole at the bottom of the shaft must be plugged and the flow checked, or all the labor would go for naught. Professional divers insisted that on account of the depth and the pressure from below it would be impossible to go down. The only other hope was to reduce the depth of water by means of pumps.

Three of these were lowered into the

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shaft and put to work, the water being reduced until only fifty feet remained. Below this the pumps could do nothing, while even a moment's suspension raised the flood. A diver was secured, and a sixty-foot pipe lowered from a working platform constructed in the shaft just above the water level. The pressure from below was so great that even with the addition of heavy weights to his apparatus the diver could only force his way downward hand over hand along the pipe. An hour after he started on this perilous journey the pipe had been placed in the crevice, coupled to others above, and the water was being taken out of the shaft.

From that day to this nothing has been taken for granted, save when a few weeks ago six workmen engaged in making repairs neglected to couple up the air shaft where they had been working and went down to a lower level, to meet death by suffocation.

That is the only disaster involving loss of life that has marked the progress of the work.

After ten years' toil in the face of obstacles that would have deterred a less determined band, the shaft has been sunk to a depth of about 700 feet. Two hundred feet further down lies a wealth of salt that will one day return to these men the money they have spent in what seemed to be a hopeless task, the fates being willing. Incidentally, it has developed engineering problems that have attracted widespread attention and won fame for the man whose determination and ingenuity, despite all obstacles encountered, made the carrying out of such an undertaking possible.

The Old Man by the Brook

Down to the vale this water steers; how merrily it goes!
'Twill murmur on a thousand years, and flow as now it flows;
And here, on this delightful day, I cannot choose but think
How oft, vigorous man, I lay beside this fountain's brink.
My eyes are filled with childish tears, my heart is idly stirred,
For the same sound is in my ears that in those days I heard.

—WORDSWORTH.

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THE REMAINS OF AN ELABORATELY FINISHED BUILDING.
One quarter of this extra expense put into essentials would have made this destruction impossible.

OUR NATIONAL ASH-HEAP

By F. W. FITZPATRICK

Consulting Architect and Executive Officer, International Society of State and Municipal Building Commissioners and Inspectors.

WE'RE a great people. Others have told us so and we modestly admit the charge. Why, even in our stupidity, our extravagances, we are magnificent and deal only in superlative figures. No nation on earth ever had the natural resources, the riches, we have squandered and wasted. Our splendid forests that were to supply the world with timber for endless ages have been ruthlessly devastated so that we now import much timber and have only recently awakened to the realization that something drastic had to be done toward the preservation of the remnants of the grand inheritance we came into. Volumes could be written about our national extravagances, but in what follows we are going to briefly touch upon but one item —Fire, the cause of our great National Ash-heap. Nor will we say a word about the carelessness of hunters and of our lumber producers, their shiftless methods that are the causes of the burning of hundreds of millions of dollars a year worth of lumber in forest fires, nor will we mention the great number of fires in steamers, ferry boats, and water craft generally but will limit ourselves to glancing at what is done in the way of combustion of buildings on dry land.

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To begin with, it is no exaggeration to assert that among our other huge investments we have over $14,000,000,000 invested in stupidity. That figure represents about the value of our inferior, burnable buildings still standing, and it also represents a sum sufficient to produce at about four per cent interest the annual cost of our fires. We often prate about the follies of other nations and usually adorn the tale by pointing at Germany's vast standing army as a terrible example of a useless extravagance, a drain upon the economies of the nation. Here we spend every year $20,000,000 *more* in fire than Germany spends upon her standing army. Still further comparisons may not be amiss in showing us our folly. Berlin with a population of at least 100,000 more than Chicago, has an annual fire loss of about $150,000; Chicago burns up $5,000,000 a year. New York City has over 12,000 fires a year with a loss of $7,000,000; London, with a million more population, has but 3,800 fires a year, and in the whole of the British Kingdom in the same period there were but thirty-five fires of $50,000 and over each, while in New York we have them in chunks of a million and more. All of those thirty-five fires in the British Kingdom cost but $3,785,000. Berlin's fire department costs it $312,000; New York's costs $10,000,000 a year. Last year we burned up $215,000,000 worth of property, and that was a normal year. In 1906 San Francisco added $350,000,000 to that "normal" amount and two years before Baltimore raised that same normal sum up an extra $90,000,000. No other nation on earth could stand this drain, and we are feeling it, for wise economists have very directly traced the panic of 1907 to the disturbance in the financial equilibrium brought about by San Francisco's destruction by fire, not its earthquake.

But that $215,000,000 does not represent all the fire cost, for we must add to it the huge expenditure we are put to for maintenance of fire departments, high water pressure and all that sort of thing that we resort to in a vain endeavor to stop the ravages of the dread devastator.

A CONTRAST BETWEEN A FIRE-RESISTING BUILDING AND THE USUAL SORT.

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Plus that, we have been persuaded into a gamble with certain gentlemen who bet with us under the guise of insurance that our buildings will not burn. That gamble costs us $195,000,000 a year in premiums. True, those benevolent gentlemen hand back about $95,000,000 of that sum in paid losses, but the other hundred millions go to the "house," the "kitty."

Add these various items and you will find that $600,000,000 is just about what fire costs us a year. We talk a great deal about the vast amount of building we do, but in our very best year, our fattest building year, we added in new buildings and repairs to old ones but a little over $600,000,000 worth, so that with all our great activity we are producing just about as much in dollar value as we are destroying. Not a brilliant showing, certainly, for the wisest people on earth.

Eliminating the cost of fire incidentals in the way of fire departments, etc., and considering just the cost of smoke and ashes the total has been in five years' time $1,257,716,000! Our population is not increasing at anywhere near the ratio of our fire losses. In 1876 these latter amounted to $64,000,000; in 1906 they had climbed to $500,000,000. Fire without its accessories costs us the equivalent of a tax of $2.33 per capita per year; in 252 of our American cities it averages $3.10 a year; in all of Europe a similar tax is a trifle less than 33 cents per capita; in Italy it is 12 cents; in Germany it is 49 cents; in thirty foreign cities where fires are most common the average is 61 cents. We have 4.405 fires to each thousand people; Europe has 0.86 per thousand. If we had been as sensible in building and used as many safeguards about our buildings as our European cousins do our fire loss would have been reduced $175,000,000 a year. Rome has $56,000 of fire loss per annum, while Boston, a city of similar size, indulges in $1,500,000.

But that is our property loss. Note, too, that we have also allowed as many as 7,000 human lives to be destroyed in a year's time.

Wood has been our undoing. The availability of lumber, the possibility of its being quickly put into shape and its cheapness (formerly) were incentives that made us use it so extensively, while the Europeans, with less lumber and more sense, built their buildings of at least incombustible materials. But the habit has clung to us so that even today, with lumber away up, 100 per cent dearer than it was a few years ago, and

A MERELY "INCOMBUSTIBLE" BUILDING.
Mistakenly supposed by the layman to be "fire-proof." Built of steel, sheet metal, etc., but can be utterly ruined by fire.

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with fireproof buildings costing not over ten per cent or twelve per cent more than wooden contraptions, our last year's record shows, nevertheless and notwithstanding all this, that sixty-one per cent of our new buildings were of lumber, tinder-boxes, additional fuel for certain fire!

Of all nations, only Russia has more buildings than we and only a few thousand more. Here we have 12,000,000 in round numbers but valued at nearly $10,000,000,000 more than the Russian. But of all that great mass of construction, scattered over the miles and miles of our country, there are scant 8,000 in which the slightest attempt has been made at fire-prevention. The others are doomed either to be torn down and replaced with better or to be burned. And in that burning all our lives and our goods and our chattels are daily imperiled, indirectly at least. Directly, 36,000 human lives are daily endangered. That is, that number of people narrowly escape, are carried out of burning buildings, jump from windows, etc., etc.

Of course, the chief cause of fire is stupidity, but are you interested in knowing more in detail the direct and immediate causes of fire? From year to year these vary and in different cities the variation is marked, but averaged about as well as it can be we find that overturned lamps cause 13 per cent, gas 6 per cent, leaky chimneys 4 per cent, sparks 7 per cent, spontaneous combustion 1/10 per cent, incendiaries 4 per cent, machinery 8 per cent, rats 5 per cent, lightning 3 per cent, electricity 7¼ per cent, while 40 per cent of our fire loss is from communicated fire from building to building and generally via the window route. There is where European methods count most, their fires are usually confined to the buildings in which they originate; here, spite of the tons and tons of water thrown into a fire, two, three, ten, forty, a hundred buildings, are often clean swept in one fire. Incidentally, somewhere in the neighborhood of 50,000 buildings were destroyed in San Francisco. Now then, had the principle of isolation been even moderately carried out in that city, not a hundredth of the waste would have occurred. Fire originated in probably not over a dozen spots

A Distorted Steel Column, "A," the Result of Warping from Insufficient Fire Protection.

but from those it radiated in every direction. Had that principle been used even in the tall skyscrapers and had $60,000 more been spent in protecting their windows, their contents at least, something like $10,000,000 would have been saved.

Speaking of San Francisco we are reminded that our insurance friends, perhaps unconsciously, but nevertheless materially, helped that city to its doom. Its people had the foolish notion that wooden buildings were safest on account of earthquakes. The insurance folks must have known the terrific fire hazard that was being developed with so much wooden construction. But San Francisco's fire department was an excellent one and on that account insurance was given at a ridiculously low rating. People

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gauge their building excellence largely by what the insurance folks demand. And so San Francisco was virtually a wooden city. So also is New Orleans. So are many parts of New York and of Boston and of all our large cities, and so are all

A FIRE IN THE HEART OF DOWNTOWN CHICAGO.
Fortunately the adjacent buildings were really fire-proof.

our smaller cities and towns. And so was Baltimore. Two of them have paid the penalty within two years of each other, and it is only a question of time when whole sections of New Orleans and of Philadelphia and of Boston, far greater sections, too, than Chelsea, of the last-named city, will also go by the board. In San Francisco the excuse was that the water mains broke and the department was demoralized; in these other places there will be some equally good reason for the spread of a terrific conflagration.

Speak of fire and the average city and the average individual will immediately think of curative agencies, brave men, wondrous water-towers, beautiful red and brazen fire engines. Suggest fire-prevention and the man is astounded. He never thought of that before. The same thing used to obtain in so far as smallpox and yellow fever and kindred ills were concerned years ago. They were looked upon as necessary evils. They were expected, and when they came upon us we expended much energy and money in trying our best to take care of the cases that developed. We built special hospitals. Then, someone thought of *prevention*. At first he was considered a fool, but little by little we adopted more or less sanitary measures and cleaned up our cities and already we have gotten to the point where epidemics of those old-fashioned ills are absolutely unknown.

So it is with fire. We have built badly, foolishly, and we have spent enormous sums in water and more water in attempted cures, but little by little we are awaking to the realization that fire is easily preventable. And that the very first principle of prevention is to build our buildings so that they can not burn and so that they will afford the maximum of protection to their contents.

The heart-breaking feature of it all is that the only thing we can do is to refrain from adding additional fuel. Still fire is eating out at a pretty lively gait. For instance, in the first month of 1908 we built new buildings and repaired old ones, etc., so that there was $16,000,000 expended in construction, but during the same thirty days fire cleaned up $24,000,000 worth of property. There was a case of destroying more than we produced. And if we continue at that rate, fire will very soon eliminate all our combustible contraptions.

Do you care to know the proportion of how buildings burn? Well, week by

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THE PARKER BUILDING FIRE, NEW YORK CITY, JANUARY 10, 1908.
Four thousand dollars "saved" on construction, in fireproofing, and $2,000,000 of property destroyed by this false economy.

week we average three theaters, ten schools, two hospitals, twelve churches, three public halls, three department stores, two asylums, two colleges, two jails, six apartment houses, twenty-six hotels, 140 flat buildings, and about 1,600 homes. In whichever class of these is your habitation, remember this, that it may be the next to burn; your property may be the next to be destroyed and your life may be the next sacrified to our national folly! You may think perhaps that not being a property owner you are not interested in the subject. But you are, and vitally.

Insurance alone on our inferior buildings, by reason of the ever present conflagration risk, is a very considerable item, properly chargeable to construction. I have complained that insurance rates upon wooden construction were not high enough to make that mode prohibitive, yet we pay a premium twelve times higher than they do in Great Britain, and twenty times higher than the Italians. We have poured into the insurance companies' coffers $1,610,000,000 in premiums in the last ten years. And we are absolutely at the mercy of the insurance companies. They will make a low rate on comparatively isolated buildings and a man will gauge himself accordingly, and thinks if the insurance companies do not exact it he need not build so very well. Then other people build around him and the general average is a poor order of construction. In course of time, the insurance companies find that the risk is greater than they at first thought and up go the rates. After the San Francisco fire, insurance rates were raised in St. Louis, for instance, from 25 per cent to 100 per cent. The insurance people know how buildings ought to be built; they advise that kind of construction; they say they encourage fireproof construction, and they have compiled an admirable code of building regulations that is suggested for the adoption of every city. But they have not made their rates on fire-retarding construction low enough to make the individual see and believe

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that this sort of construction *is* the proper thing.

The only expedient we can resort to and that all intelligent, thinking men should endeavor to bring to a consummation is to have good construction made compulsory. State and municipal regulations can do it. The building speculator, the Buddenseick, the fellow who builds a match-box and paints it well and sells it within thirty days to the guileless investor, is the man who is going to howl that strict building regulations are a hardship upon the poor man and will impede progress. And, mark you, those same speculators exercise wonderful influence in municipal affairs. To get reasonable building regulations is a colossal task. We have secured the first steps in that direction in over a hundred cities in this country within the last three years, but it has been a desperate fight in every case.

No halfway measures nor compromises will avail much. Our building regulations should regulate and what's more, they should be enforced; hereafter every building constructed should be made fire-resisting and no time should be lost in correcting the principal faults about the old ones so as to make them, bad as they will remain, as little dangerous as possible.

A COLLAPSE IN THE PARKER BUILDING, CAUSED BY FAILURE OF UNPROTECTED STEEL COLUMN TO WITHSTAND THE HEAT.

The great thing in fire-prevention is to realize that fire is bound to occur in the contents of buildings at some time or other and that buildings should be built so that the structural parts will afford nothing for fire to consume, no means of carrying fire, and that that fire shall be confined to as small a space as we can possibly get it in its incipiency. There it can be controlled and extinguished before it becomes other than incipient. The same principle of isolation should obtain as regards buildings as we have shown in regard to parts of buildings. Make it so that fire cannot communicate from one building to another. The window route is the most common for fire, there-

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fore our windows should be of metal sash and wire glass and where the exposure is very great, these windows should be double-glazed with wire glass. Then again precedent impels us to fill our offices and houses with wooden furniture; there is no sense in it. Steel furniture offers a great deal more protection, is not combustible, is more cleanly, occupies less space and is better in every respect. There is bound to be in every building enough that is inflammable without adding anything thereto that can possibly be made non-inflammable. And the thing that should be used most, that is most glibly referred to, and that prevails less in our buildings than any other one commodity, ingredient, or principle, is common sense. If a man would but stop and think twice before doing any of the fool things that are so commonly done in our buildings today, he would hate himself for having been so near doing it. Perhaps that's an Hibernianism, but it conveys my idea, so I'll let it go at that.

The Days That Are No More

Dear as remembered kisses after death,
And sweet as those by hopeless fancy feigned
On lips that are for others; deep as love,
Deep as first love, and wild with all regret;
O Death in Life, the days that are no more.

—Tennyson.

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WEALTH FROM AN UNDERGROUND RIVER

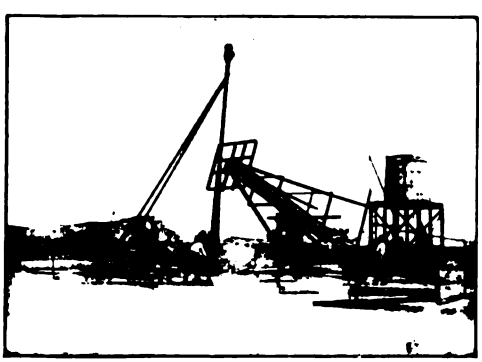
By Harold Dunton.

Much development in the way of government and private projects for the irrigation of the Colorado desert, the Salt River Valley and the barren parts of eastern Oregon has been done, but there is an immense stretch of country, most of it level as a floor, lying to the east of the Sierra Madre Mountains in Southern California which yet awaits the plow and the water canal. This is the Mojave Desert, on which it is probable that more men have died in search of gold than any other equal area in the world. Now one man has invaded the Mojave Desert, and, following out a theory of his own, has won from the barren land a home and a large rancho which bids fair, in a few years, to make him one of the wealthy men of the West. Below is the story of how he did it.

IF he who makes two blades of grass grow where but one grew before is greater than the builder of cities, then there is a man in southern California, a pioneer of civilization along agricultural lines, who has done more than all the builders of all the cities since time began. He has made, not two blades of grass to grow in place of one, but whole alfalfa fields where there was nothing but a stretch of glaring sand; in place of sage brush and greasewood and juniper he has in successful growth orchards of apples and pears and plums; green fields of barley and corn turn to the yellow of early ripeness under his hand, and where the jack rabbit and the coyote, the crawling lizard and the hissing rattlesnake ruled the land he has set his home, carving the way for other men to come with him and share in the riches of an undiscovered farming land lying at the very doors of civilization.

The man is W. G. Dobie, a physician of ability, a globe trotter of years' experience, turned ranchman on the Mojave to prove or disprove an idea which had its origin in a casual trip across the great sand plat. This idea, which was that a great body of water, either lake or river, underlies the entire Mojave desert, he has completely proved, and he is now on the eve of reaping the rich harvest of his idea.

About one hundred miles from Los Angeles, twenty miles beyond the eastern mouth of the Cajon Pass, the gateway in southern California, lies his ranch, seven miles from the little town of Victorville, on the Salt Lake Railroad.



Erecting the Irrigating Wind-Mill.

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Behind him rises the wall of the mountains, snow-capped in winter, filled with rippling brooks of life-giving water in summer. Out from his door, beyond his green and yellow fields rolls the desert, away through the foothills, breaking into a level plain which stretches away to the east until it is lost in the blue haze of distance.

Victorville has been a town for years, noted principally for the excellent sport hunters had there shooting jack rabbits. It also has some reputation as a health resort for lung diseases, but beyond this it was a town simply because it had been a watering place on the old trail, long before the iron horse woke sleeping hills of Cajon Pass with its siren blast.

The great West of half a century ago is no more. The West of today is the great, untried, little-known desert. Fertile as any of the lands on which stand California's millions of dollars' worth of orange groves only lacking the water which has filled coastal acres with the apples of Hesperus, the Mojave Desert has shown itself a new empire, opened to settlement by the theory, the energy and the perseverance of one man.

Dr. Dobie has worked silently. When he went out to Victorville about three years ago, with his wife, his sister and a friend who held like ideas as to water, no one knew of his going, no one was burdened with the story of his plans. Today he has a fine home, as desert homes go, an abundant supply of water, and, stretching away to left and right of his home, well tilled fields of barley and alfalfa, with orchards of all manner of deciduous fruits.

THE LAST RESTING PLACE OF A DESERT FAILURE.
Drought and heat have done for this desert rancher.

The twentieth century pioneer took up a tract under the Desert Land Act, and then set about getting water on it, without which he must fail in his project and lose his land as well. For years, men who have looked at the Mojave Desert have declared that it was impossible to get water on it; that there was no way by which the precious fluid could be brought from the mountains and impounded, so as to furnish irrigating water at a time when it is most needed in the summer.

More than this, they said that the places where water could be found by drilling were few and far between; that no great body of water underlaid the desert; that all the hundreds of streams that rush out of the mountains to sink away in the friable soil of the plain went down so deep that they could not be reached by any manner of drilling known of man. Believing this, they turned their attention to the Colorado and other sections of the desert, letting the Mojave lie as it has lain for cen-

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BEGINNINGS OF A TOWN ON THE MOJAVE DESERT.

turies, a useless waste of parched and arid land.

Now, Dr. Dobie had unbounded faith in his theory that there is water in a vast body under all of the Mojave Desert. During the first year, not being able to find water on the land he had taken up, the fluid was hauled from Victorville to supply himself, his family and his horses. Eventually he did find water, small in amount and brackish in taste. Then he reasoned that if this surface water underlaid the desert, there should be more abundant and better water deeper down.

THE FIRST LOAD OF HAY.
The soil was watered by subterranean stream.

Men and teams and drilling outfits were brought in; one, two, three hundred feet, straight down through sand, gravel, hardpan and finally the bed of cement which is found beneath the entire floor of the desert, until at a depth of more than three hundred feet an abundant supply of sweet, fresh water was found. In addition to his theory of the great subterranean supply, Dr. Dobie had believed there would be force enough to this confined water to raise it to the surface in flowing wells. In this he was disappointed, but he found an endless supply of water, which could be pumped to the top of the ground.

A gasoline engine was set up, after repeated failures in the drilling, in which tools were lost, rigs blown down and holes caved in, and water enough secured for domestic purposes and for the use of the stock. But it was soon seen that the long haul by which gasoline had to be brought in for the engine precluded the possibility of using it as power to lift the water from the underground river. Soundings in the well proved it practically bottomless. The lead went down until it could no longer be controlled by the man at the surface, and was carried swiftly to one side, with a strength which the operator was scarcely

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Dr. Wm. Gowan Dobie.
The man who has opened the Mojave Desert in southern California to successful cultivation.

able to withstand. It was with the greatest difficulty that the cord and lead were withdrawn from the well, and the frayed condition of the cord showed that it had been rubbed on the rock roof of the subterranean channel with great force by the power of the water.

It was found necessary to adapt some other power to the pump. In this section of the desert there is a wind which blows for a time each day from a certain direction every day in the year. An ordinary windmill was erected, a mill of the most modern kind, with steel tower. The second day of its life it was blown down. Then a squat, four square derrick, home-made and of low height, was set up. On the top of this was set a double power windmill, with two fourteen-foot wheels. Against this mill the desert winds exerted their utmost strength, but without avail, and today it is drawing from the inexhaustible supply of the underground river a man-made flood with which the grain and hay fields and the orchards of various fruits are being irrigated in as thorough a manner as are any of the orchards of the Pacific Slope.

Hay Cut on the Dobie Ranch.

Interesting it is to note that under analysis the waters of this hidden stream show remarkable purity and excellence for table use. The flood which pours out of the large, double-power pump is soft, clear as crystal, with a total of mineral solids of only 15.30 per cent. On the outlying sections of the large farm, in every direction from the present well, experimental holes sunk with diamond or core drills have shown the same abundance of water, indicating that the stream is of great width, probably Nature's drainage canal for the entire eastern slope of the Sierra Madres and other small ranges which wall in the desert on its western rim.

These wells are finger boards to the greatest discovery which has ever been made on the Mojave Desert. Beside their value the wealth of the Yellow Aster, the Mohawk, and all the other bonanzas which mining men have uncovered amid the low buttes of the great plain pales almost into insignificance, for Dr. Dobie has proved that this vast area of land can be converted into waving grain and hay fields and green-leafed orchards.

Three great things, great in any generation of any nation's life, this quiet, unassuming man has accomplished:

He has opened an area of thousands of acres of barren land to settlement,

Breaking the Ground for the First Crop.
Scene on the Dobie ranch.

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in which the settlers may obtain the land for a song.

He has proved that under this entire stretch of ideal farming lands there is an abundant, easily-reached supply of water, more than sufficient to irrigate all of it.

ORIGINAL ORCHARD TREE OF THE DESERT.
Thousands of these had to be cleared from Dr. Dobie's land before he could proceed with his remarkable work.

He has shown to those who may come after him how each one of them can conquer the forbidding desert; how the laborer, stifled on his forty foot lot or in his tenement rooms can go to the free West, and, under the finest, most healthful skies in the world, become his own landlord.

Acres on acres of the Dobie Ranch, onto which the waters from the underground stream have not as yet been brought, are being made productive under the Campbell system of dry farming, but the return from that land which has been supplied with water is so much greater than from the dry acreage, that Dr. Dobie does not believe in toying with the latter except to fill in the time until ditches can be dug and pipes laid to carry the life-giving fluid all over the ranch. It should be mentioned here, however, that all of the doctor's garden is cultivated on the dry land, and from it he has produced some of the finest onions and potatoes ever grown in the Southwest. Markets for all manner of garden produce are abundant on the desert, and ruling prices are high. Practically all the vegetables used in the mining camps and railroad and stage stations of the desert must be shipped in from the coast, a slow and expensive method of getting supplies. All the long, wide slopes stretching along the mountain wall is reached from most of these towns and camps by fine roads, over which the hauling of vegetables and other garden fruits can be done without hardship to horses or men. Some of the profits in truck farming for these towns may be imagined when it is told that onions range from fifteen to twenty-five cents per bunch—selling on the coast for five cents—and that potatoes, worth on the coast one and one-half to two and one-half cents per pound, sell in the desert towns at five to ten cents per pound.

Deciduous fruits alone promise to be immensely profitable. Where the demand for vegetables and general farm produce is as great as it is on the desert, it is but natural that the supply of fruit is always insufficient to meet the needs of the people whose mainstay often is bacon and beans.

Apple trees, set out three years ago by Dr. Dobie, are in bloom, and give ample evidence of an abundant crop soon to come. Peach, plum, pear, apricot, cherry, white mulberry, Russian mulberry, prune and fig trees are in excellent condition. English walnut and eucalyptus trees have been planted at a later date than the fruit trees, and give evidence of successful growth. Oranges have not been tried, but further south, on the Colorado desert, good luck is attending those who have planted these trees around Brawley and Calexico, so that Dr. Dobie is encouraged to the belief that he can grow oranges on his

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ORIGINAL "HOUSE" ON DOBIE'S FARM.

desert ranch. He will experiment with various varieties this year.

Spineless cactus has shown remarkable growth at the Dobie ranch, though the first clippings were set out only a few months ago. Other varieties will be set out as fast as possible on the land above the well, where water can only be distributed with difficulty and by lifting it with force pumps. In addition to forage for cattle and horses, it is planned to try to create a demand for the fruit of the spineless cactus in the desert towns. This fruit is widely used throughout Mexico, and there Dr. Dobie received the idea of using it on the desert as a table fruit. It comes into full ripeness at a time when there is little other fruit to be had, even in sun-kissed California, and should be another wealth producer for the man who has conquered the Mojave Desert.

And who is this man? Born in Dunfermline, the native town of Andrew Carnegie, he is a Scotchman, from the top of his gray hat to the soles of his broad-toed shoes. Persistent in his ideas, determined to make his theories come true, whether fate so decrees it or no, he is a man of indomitable will and purpose. Not alone is he working for personal aggrandizement, though this is already within his grasp, but for the good of the country and of the people who may come after him, seeking new homes.

When Dr. Dobie found, after years of the hardest kind of labor and experiment, that it was impossible to develop enough water from the surface of the ground—i. e., from the streams which, flowing out of the mountains, lose themselves in the desert—he went about on a new tack, and, still conforming to the law, brought the water which these streams buried beneath three hundred feet of earth to the surface.

In this last-named work of his lies one of his greatest gifts to the people of the nation. Hundreds, probably thousands, of poor settlers on the desert have been forced to give up their little claims because they could not meet the water development requirements of the Desert Land Act. In other words, they were unable to bring to their lands enough surface waters to insure crops. Dr. Dobie's discovery of the underground river and how to develop it has given these people a new hold on life, and he has opened the Mojave to the poor man as well as to the rich corporation—for irrigation projects cost, not hundreds of dollars, but hundreds of thousands.

Hundreds of invalid desert land claims, according to Gen. Frank C. Prescott, registrar of the Los Angeles Land Office, will be turned into fertile, productive homesteads, and thousands of new settlers will be brought into the

THE WATER EMERGING FROM THE UNDERGROUND RIVER.

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Mojave all because one man with a theory and an unconquerable desire to make that theory come true has won from the powers of the barren waste a home for himself.

On the Mojave, scarcely half a day's run from a city of 300,000 inhabitants, Dr. William Gowan Dobie is as much of a pioneer of a new world as were his ancestors, the Gowans of Australia, half a century ago. His achievement is of the greatest importance not alone to the Pacific Coast, but to every man and woman in the United States, because it is the opening up of a new field of endeavor, a step toward the reclaiming of vast, supposedly-arid areas, which will supply the demand of the ever-increasing population of this country for independent homes.

TURNING PINE BARRENS INTO GOLD

By LEONARD SHELDON

WHEN the lumber barons held full sway in Michigan, Wisconsin and Minnesota a quarter of a century ago they left desolation in their wake. The pine forests that constituted one of the most valuable natural resources were cut away with a ruthlessness born of the apparent belief that there was no limit to the source from which fortunes were being made.

The goose was killed, however. What the timber cutters didn't destroy forest fires did, leaving as a heritage millions of acres of pine barrens, regarded as absolutely worthless. Colonization was next to impossible because of the labor and time involved in ridding the land of stumps and getting it ready for cultivation. It was a physical impossibility to clear and plant a sufficient tract the first year on which crops could be raised that would enable the settler to eke out an existence. At this late date much of the territory devastated by timber cutters is so stump ridden there is little or no in-

THERE IS GOLD IN EVERY ONE OF THESE STUMPS.
Millions of the dead remains of the fallen forest monarchs have now been found by the chemist to be sources of wealth.

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EVERY STICK OF PINE THAT IS LEFT IS TO BE USED.
Places like this where lumbering is over for the present still have great value for the man who knows how to take it.

ducement to locate there, even though given the land free of cost. Thus it is that these millions of acres of barren waste have stood year after year, a monument to the thrift of a few who profited at the expense of the many, and a forcible reminder of what should not be.

Now the pine barrens are to be turned into gold through the magic touch of the chemist's hand, and the land that has been so forbidding will be rendered fit for cultivation.

A few years ago the suggestion that these billions of charred pine stumps possessed the slightest value would have been derided. One dollar an acre has been considered a prohibitive price for the lands thus encumbered, and the man possessed of sufficient hardihood to settle amid the barrens was regarded with mingled pity and suspicion as to his men-

One of the Mills Where the Pine Stump Is Made to Give Up Its Wealth.

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WASTED AND STERILE LAND.

tal soundness. Many of these settlers made good, it is true, but the prospect was terrifying to thousands of others who would have flocked into the country had it not been for the time and labor involved in digging out the old stumps and destroying them.

All this will shortly be changed. With the rapid depletion of the Norway pine forests, and the consequent falling off in the source of supply of by-products, inventive genius began to assert itself. The pine stumps, rich in resinous properties and turpentine, had long been regarded with interest by chemists, who believed that they could be converted into a source of wealth. How to do this was the problem confronting them, which appears to have received a practical solution. And in the working out of this problem wonders have been performed that make Aladdin's lamp appear commonplace by comparison.

Destructive distillation is the process employed in securing turpentine and by-products from these pine stumps that were once regarded as a curse, but are now hailed as a new source of wealth. The shredded and broken wood is piled on cars capable of holding about two

AN INCIPIENT FOREST FIRE.

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A REGION IN THE ADIRONDACKS REPEATEDLY BURNED OVER.

cords each and run into huge retorts. The intense heat encountered here drives out the pitch and tar as well as the moisture, leaving in place of the two cords of wood some thirty bushels of excellent charcoal.

The fluids are subjected to chemical treatment which separates the turpentine from the tar. The former is then carried through pipes to a copper worm not unlike those employed in distilling liquor, where it is condensed and flows into tanks. By a siphon process the water is removed from the turpentine, and the latter is ready to be refined.

While all this is going on, the pine tar is carried off in a fluid state through pipes, and when cooled is ready for commercial purposes. It is at this stage that the wonder working begins. Tar is always salable at a good figure. When it has been still

A RECKLESSLY LAID FIRE-TRAIN.

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further treated and the by-products extracted the profits swell appreciably. Synthetic chemistry is employed in handling the pine tar, and as a result acetic acid, formaldehyde, creosote, acetate of lime and wood alcohol are forthcoming. When all these valuable commodities have been extracted from the pine tar there still remains a residue that, synthetically treated, furnishes the basis for an almost endless variety of chemicals and colors. Among the by-products obtained in this manner are embalming fluid, guiacol, a tree spray, shingle stain, sheep dip, metal polish, almost any color of paint and several varieties of lacquer. What future experiments may bring to light can only be conjectured, but it has been shown that the pine stumps so long a reproach are destined to play a prominent part in the industrial world.

At present two plants are in successful operation in Michigan, and others are being installed. The plan followed is one whereby the best results are obtained by the most direct route. Portable distilling plants operate in the woods. In this manner as fast as one section has been stripped of stumps the outfit can be moved elsewhere, and the performance repeated. The crude products will in turn be shipped to a central refinery, from which will be produced the turpentine, tar, acids, charcoal, wood alcohol and other by-products that always find a ready sale at a good figure.

A dynamiter, one man and a team will keep a plant supplied with stumps. There are millions of acres of these pine barrens, from which the owners would be only too glad to have the stumps removed. Thus it comes that for the taking there is available a supply of material sufficient to keep scores of these plants in operation for several generations.

Not the least important feature in this connection is the influence that will be exerted on further settlement of these sparsely populated districts, and the development of rich agricultural communities where now is only desolation. Primarily, this move means that hundreds of men will be furnished employment in the distilleries, and that capital will reap rich returns on its investment. But of far greater consequence to the states where this transformation takes place will be the fact that millions of acres of land will eventually be reclaimed; millions of dollars added to the taxable property, and thousands furnished homes and a means of livelihood where now stand only blackened pine stumps.

The Storm

O night
And storm and darkness! Ye are wondrous strong,
Yet lovely in your strength, as is the light
Of a dark eye in woman! Far along,
From peak to peak, the rattling crags among
Leaps the live thunder.

—BYRON.

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LEWISTON SUSPENSION BRIDGE ENDANGERED BY ICE-JAM
This bridge is 65 to 85 feet above river at normal.

THE ICE-JAM AT NIAGARA

By ORRIN E. DUNLAP

ON the night of April 9, last, within a radius of several score miles of Niagara Falls, electric lights suddenly winked out, and machinery depending upon electricity for power came to a standstill. The Niagara River, ice-jammed below the Falls, had risen forty feet, flooding the station of the Ontario Power Company, located at the water's edge on the Canadian side.

Ordinarily, this power house is twenty-eight feet above the level of the lower river. Now the swollen torrent overwhelmed the peaceful, busy station, flooding the machinery and depositing hundreds of tons of ice on the floor.

In the past Niagara has had its ice bridges close up by the Falls, and frequently these structures have been referred to as "jams," but since the gorge was transformed into a reservoir and the flow of the mighty river to Lake Ontario was temporarily stopped, the word "jam" has a new significance in that locality. Indirectly, the Niagara ice jam was the result of a terrific gale that had swept over the Great Lakes. It tossed the waters of the upper lakes and broke up the ice fields of shallow Erie. It carried the shattered ice before it to the entrance of the Niagara River channel at Buffalo,

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A MOUNTAINOUS MASS NEAR THE FALLS.

where it left the great cakes to the mercy of the swift currents to be transported to and over the Cataract of Niagara.

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BLASTING THE GREAT NIAGARA ICE-JAM AT THE MOUTH OF THE RIVER.

This ice floe of the early days of April, 1909, will long be memorable for its vastness. From Buffalo to the Falls the river was coated with its frozen freight. Passengers on trains and trolleys viewed it with amazement. Over the reefs, over the Falls, plunged the mass, and then it floated out from under the waterfall and continued toward Lake Ontario.

Running along the New York bank of the river was one leg of the scenic electric belt line enjoyed by thousands annually. High over the greater part of this roadbed the ice and water went, and as the river settled back to its channel it left from ten to twenty or more feet of ice over the tracks for three miles or more, the greater part of which had to be shoveled off by an army of men. The roadbed was damaged to an unexpected extent, while poles and wires were carried away by the crush and tumult of the jam.

Lewiston, N. Y., and Queenston, Ont., are located on the river just beyond where the deep gorge stops, and there, in that wide portion of the river, the ice kept climbing higher and higher until boathouses, private pumping stations and docks were ruined. High on the river bank at Lewiston stand two hotels, the

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summer peace and beauty of their sites having fascinated many as they took the boats for Toronto on the docks below. But this jam turned the peace to real danger. It piled up, up, up, until its rough cakes crowded the rear veranda of one of them. Men chopped it away day after day, and the veranda was roped to the main part of the building to save it. Never before had the river bank been touched to that height by the river or the ice. It was difficult to understand why such conditions should be. It was evident that unless something were done to relieve the situation much property would be lost, and perhaps lives, too.

John A. Merritt, collector of the Port of Niagara, called the attention of the United States War Department to the seriousness of the jam. United States engineers were instructed to report on it, but did nothing of moment. Residents of Lewiston turned to Governor Hughes of New York state for help. He directed the state department of public works to act. This sent Assistant State Superintendent Kunzie to the Niagara frontier. He had had previous experience with ice jams, but not in such a river as Niagara. He was quick to act. He bought several tons of dynamite, and that night it was carried across country on wagons to Fort Niagara, at the river's mouth on the New York shore. He had decided that sandbars at the mouth of the river had assisted in creating a jam—that actually the Great Niagara was no longer finding its way to Lake Ontario. The gorge had been turned into a reservoir. Every minute the Falls of Niagara was delivering into this reservoir millions of gallons of water and thousands of tons of ice.

WHERE THE GORGE ROAD EMERGED FROM THE ICE-JAM.

Blasting was begun opposite Fort Niagara. Men carried the explosive out to a favorable spot on the ice jam, where it was sunk in the mass, there all of sixty

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feet thick. Lumber and timbers were placed over the mine in order to give force to the dynamite when exploded.

Next morning it was seen that the river was again traveling its old route and was reaching Ontario. More blasting was done the next two days, but the river from this time on did the greater part of the task of clearing away the jam. By Sunday, April 25, a channel had been split through the ice up to Lewiston, a distance of seven miles, and as the ice floated away on the revived currents it removed the danger from about the Lewiston suspension bridge, a structure originally swung sixty-five feet above the water, but which in the time of this jam had every one of its guys parted by the ice, which reached within fifteen feet of the deck. It was feared that a sudden rush of the ice would carry the bridge away. When the river was clear of ice, the International Railway Company took a big rotary snow plow to Queenston, Ont., to remove the ice-deposit from its tracks there, this scene of a snow-plow working at Niagara in May being a most unusual sight.

ICE-JAM CROWDING HOTEL AT LEWISTON.
Forty feet above normal water.

The total damage done by the jam was estimated at over one million dollars. But more impressive than this loss is the new question which now confronts engineers as to the safety line in the Niagara Gorge. This scenic spot has four wonderful bridges, two of which, at least, were endangered by the ice jam, while the power plants located there alone cost millions of dollars.

Woman

Auld Nature swears the lovely dears
Her noblest work she classes,
Her 'prentice han' she tried on man,
And then she made the lasses.

—BURNS.

ENGINEERING PROGRESS

BALLOON BUILT IN SECTIONS

IN order to facilitate the transport of airships, e. g., during voyages of exploration, and in warfare, and also to allow an injured balloon to be conveyed back to its shed by land, a German inventor, Mr. Weissenburger, of Offenbach, suggests the use of composite folding airships made up of several sections which moreover would not require any large halls for storing.

The model of such an airship which has been recently perfectly consists of eight identical sectional balloons, each of which, when erected, takes the shape of a cylinder with two rounded ends that can be folded down umbrella-wise by a crank. As those sections are combined to a composite rigid airship, the rear cap is turned over so as to fit round the head of the balloon next in order. Owing to the absolute equality of those sections, any balloon that is injured can be readily exchanged for a reserve balloon, the gas compartment and frame of each section being entirely self-contained, comprising, for example, identical points of attachment for the rudder and gondola. Owing to this construction of the airship, each sectional balloon can further be used by itself as a captive balloon for military purposes or as a racing balloon. In the latter case the frame is readily removed. On account of its oblong shape, the section then is quite adapted to be used as a small dirigible balloon which, after being fitted with a removable motor, with its fixed gondola, is able to sail in any direction independently of the direction of the wind. This obviously is especially advantageous for sporting purposes and in warfare for fortress service.

A sub-division of captive balloons would be especially advantageous, allowing self-contained individual balloons to be carried with their gas charge by small army detachments, while larger detachments would be in a position to form a large airship out of these sectional

THE MODEL OF THE SECTIONAL BALLOON.

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A Section in Flight.

balloons, which work could be performed in the very short time of two hours.

TEAMING IN THE MINING COUNTRY

THE difficulties encountered in transporting heavy mining machinery into the Montreal River and Elk Lake silver mining camps in the Cobalt District in Northern Ontario are very great. The large boiler shown in the illustration is mounted on double bobsleighs, and ten horses attached to it by heavy chains, are required to draw it. It was taken up the ice on the Montreal River for some fifty miles. The contract price for teaming it to that point was four hundred dollars.

A new mining district is now being opened up at Gowganda Lake, where several rich discoveries of native silver are reported to be made.

A winter road is now being constructed through to this new silver camp via Elk River, and the Canadian Northern Railway is proposing to extend their line from Sudbury to connect with the Temiskaming and Ontario Railway at Englehart.

ELECTRICITY OPERATES GYROSCOPE

ELECTRICITY has been applied to the gyroscope during a series of demonstrations of the machine's action in connection with a monorail car driven upon the upper side of a single stretched wire, which were given at Columbia University recently by Edward Durand. The apparatus was set in motion by the simple switching on of the current and rotated at a constant speed, which could be regulated as desired.

This gyroscope was built by Charles E. Dressler, of New York, who invented and constructed the first electrically driven gyroscope ever made, fifteen years ago, in a laboratory connected with the College of the City of New York. The rotating part comprises a specially constructed armature whose shaft is mounted on gimbals so that the rotating disk can take any position. The inner ring of the gimbal is composed of an inner and an outer ring, insulated from each other and forming a bipolar field.

Current admitted at the posts passes up through the insulated pedestal and around the extreme outer ring to the inner and outer rings of the bipolar field, where it energizes the

Hauling Machinery into the Cobalt Mining District, Ontario.
It costs $400 to team this load fifty miles.

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ELECTRICALLY-OPERATED GYROSCOPE.

armature and thus starts it to rotating.

The instrument stands 12 inches high, operates with 1½ amperes at 20 volts, and can be run from a 110-volt direct current lighting circuit by connecting in series with a 50-candle power lamp.

The application of electricity may prove of value commercially.

MORE SUBMARINES LAUNCHED

THE *Stingray* is one of three submarines recently launched at the Fall River ship yards, Quincy, Mass. It is of the Holland type, and measures 105 feet in length. The vessel gets its name from the stingray, a species of fish that does exactly as its name indicates, "stings." It is a significant designation for a war vessel.

ODD TYPE OF FLIER

NO flying machine of the heliocopter type, in which the ascensional and propelling means consist of one or more propellers arranged in a horizontal or slightly inclined plane, has proved more than remotely encouraging in tests, still many of the rapidly growing number of flying machine experimenters continue to spend their efforts in this direction. One of the latest heliocopter productions is that of the Englishman, Dupont, which is shown in the accompanying photograph on the following page.

The machine is of small size and is driven by the feet of the operator, who reclines in doubtful comfort and stargazes while his machine alights perhaps

NEW SUBMARINE *STINGRAY* FOR UNITED STATES NAVY.

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A Difficult Position for an Aeronaut.

terial in bulk, and the merchant and manufacturer have found the hand lifting electro-magnet shown in the accompanying illustration a great convenience.

This magnet weighs but seven pounds and is capable of lifting ten to fifteen times its own weight, without difficulty, being operated on an ordinary direct current circuit of 110 volts, the current being supplied through an attachment plug connected to any incandescent lamp socket.

The coils are energized by the closing of an electric circuit, a push button being mounted on the top of the magnet for this purpose, operated by the thumb.

For cleaning chips and borings out of machinery, this device is of a great service, and for removing bolts, nuts or tools

in a mud pond. Two screw-like propellers with canvas blades or wings stayed by wires are mounted on vertical shafts. The forward one is rotated by means of a bevel gear at the end of a shaft that is chain-driven from the main shaft at high speed through the agency of multiplying chains and sprockets. The main shaft is rotated by pedals with ratchet hubs, like the star and kangaroo bicycles of some twenty years ago.

Evidently the photographer was in haste to get a scoop on this remarkable invention, for no means of driving the rear propeller is shown, although there seems to be a pulley for a belt. Furthermore, it is evident that the inventor intends to provide some means for changing the angle of inclination of the propeller shafts, in order to give the machine forward motion after it has lifted itself clear of the ground, should his expectations in this regard be fulfilled. At the time of taking the picture, however, the propeller shafts had to be held upright by rope stays secured to nails driven into the boxes. As it is unlikely that the inventor purposes to take the boxes along in his flights, it is clear that there yet remains considerable to do before the machine is ready to fly.

ELECTRO-MAGNET FOR HAND LIFTING

LARGE lifting magnets have been utilized extensively in iron and steel works to great advantage in the handling of sheet iron, steel plates, etc.

The same difficulty arises in handling tacks, nails, bolts, and other similar ma-

Handling Nails in Bulk by Electro-Magnet.

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THE LARGEST CHRYSANTHEMUM IN THE WORLD.
It is 10 feet in diameter, contains 1,200 blossoms, one year's growth. It was exhibited at the New York Horticultural Society's Flower Show held recently, where it was awarded the Grand Prize.

dropped into places otherwise difficult of access. It is also of value in picking up particles of iron or steel from tubs or paint, chemicals or other liquids, the two poles being simply immersed in the liquid.

THE RECORD IN SHIPS' CABLES

THE great increase in the size of ocean-going steamers has necessitated vast improvements in the manufacture of cables by which to moor and tow them, and of chains for the mighty anchors at which they ride. The illustration shows what is claimed, and probably justly, to be the thickest cable in the world. It is nearly twenty-two inches in circumference, 558 feet long, and 5,600 pounds in weight. Some idea of the dimensions may be gathered from the picture by comparison with the man standing alongside of the cable.

Such a cable as this would astonish the mariners of half a century back, and to the sailors of Columbus' time it would seem incredible.

A SHIP'S CABLE SAID TO BE THE LARGEST IN EXISTENCE.

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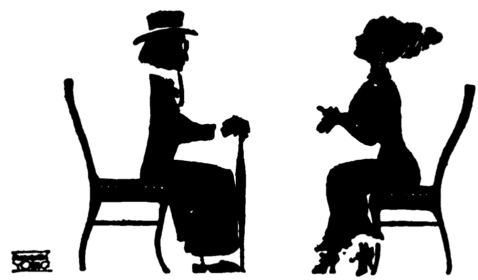
Effective Treatment

ASKED the Progressive Woman of the Beauty Culturist: "Don't you think women should exercise the suffrage?"



"Certainly. My method will increase it two inches."—*Puck.*

Very Remote Connection

"ARE you related to Barney O'Brien?" Thomas O'Brien was once asked.

"Very distantly," replied Thomas. "I was me mother's first child—Barney was th' sivinteenth."—*Everybody's.*

He Earned the Girl

"COLONEL," asked the beautiful girl, "when was the most trying moment of your life?"

"It was when I went to my wife's father for the purpose of asking him to let me have her. He was very deaf and I had to explain the matter before twenty clerks."—*Chicago Record-Herald.*

Didn't Mind If She Did

MILO—"We'll have to hurry, dear. Do you mind being pressed for time?"

MILLICENT—"For time? Oh, no—nor even for eternity."—*Cornell Widow.*

She Meant Well

SHE (effusively)—"How nice it is to have met you again after all these years, my dear Captain Burlington."

HE—"*Major* now! That was ten years ago, you know."

SHE (still more effusively)—"How time flies! Well, congratulations and good-bye. *I hope you'll be a General* when next we meet."—*Punch.*

Helping the Weak

A BIG negro and a small Italian were sawing a large timber, for the Philadelphia subway, with a heavy crosscut saw, each in turn pulling it back and forth. A pugilistic Irishman stopped to watch the operation. In a minute he hit the negro, saying: "Give the saw to the little fellow if he wants it."—*Circle.*

A Chicago Cinderella

MISS PIANIST—"I once tried playing in our church but my feet were not large enough to manage the pedals."

MR. SOFTLEIGH—"My! It must have been a big organ."—*Bohemian.*

Love's Change of Costume

HE—"In olden times women disappointed in love used to don nuns' garbs."

SHE—"Yes, but the styles have changed. Nowadays they go into breach of promise suits."—*Bohemian Magazine.*

The Cause of War

THE fair young *débutante* was surrounded by an admiring crowd of officers at the colonel's ball. Mama was standing near by, smiling complacently at her daughter's social success. The discussion was over the quarrel of the day before between two brother officers.

"What was the *casus-belli?*" asked the fair *débutante.*

"Maud!" exclaimed mama, in a shocked voice, "How often have I told you to say stomach?"—*Success Magazine.*

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A Literary Evening

As JONES wended his uncertain way homeward he pondered ways of concealing his condition from his wife. "I'll go home and read," he decided. "Whoever heard of a drunken man reading a book?"

Later Mrs. Jones heard a noise in the library. "What in the world are you doing in there?" she asked.

"Reading, my dear," Jones replied cheerfully.

"You old idiot!" she said scornfully, as she looked in at the library door, "shut up that valise and come to bed."—*Success Magazine.*

No Right to the Term

AN Episcopal minister, who had but recently moved to a small town in the Pennsylvania coal regions, passed two youngsters on the street.

"Good morning, Father," said one of them, misled by the clerical garb.

"Don't you know nutt'n?" said the other, contemptuously, when the minister was past. "Dat guy ain't no father. Why, he's married an' got two kids!"—*Everybody's.*

Why She Cut

FATHER—"I saw you in your sheath gown yesterday. How could you cut such a figure?"

DAUGHTER—"I had to, father. You see, hips are bad form."—*Harvard Lampoon.*

Breaking the News

MARION, who had been taught to report her misdeeds promptly, came to her mother one day, sobbing penitently.

"Mother, I—I—broke a brick in the fireplace."

"Well, that is not very hard to remedy. But how on earth did you do it, child?"

"I pounded it with father's watch."—*Success Magazine.*

Willing to Be Unobtrusive

POSSIBLE EMPLOYER—"But we are slack ourselves. If I found you anything to do it would be taking work from my own men."

APPLICANT—"The little I should do wouldn't 'arm nobody, guv'nor."—*Bystander.*

The Difficulty

"WHAT sorter confuses me," said Uncle Eben, "is dat after I gits a lot of advice I's got to go around an' git a lot mo' advice 'bout which advice I's g'ineter take."—*Washington Star.*

A La Directoire

BEGGAR—"My dear lady, I am without either petticoat or corset."

DEAR LADY—"The same as I. It is the latest fashion."—*Journal Amusant.*

Proper Interpretation

IN answer to the question, "What passages in Holy Scripture bear upon cruelty to animals?" one boy said: "Cruel people often cut dogs' tails and ears, but the Bible says, 'What God hath joined together let no man put asunder.'"—*Christian Register.*

A Too Modern Improvement

MR. MARTIN—"Mr. Miller is after findin' out why his cow went dry."

MISS HOGAN—"An' phwat was it?"

MR. MARTIN—"His bye, Willie, milked the poor crayture wid wan of thim newfangled, dust-suckin' machines!"—*Puck.*

Rural Philosophy

"EZRY," said Farmer Hay, "I see that since ye have come back from college ye wear yer hair spliced right down the middle. Now, hyur's all I have to say: If ye expect ter feed out o' my trough, ye got to let your mane fall on one side."—*Puck.*

Fortunate

COOK—"Taylor was always a fortunate man, but doesn't it seem wonderful that his luck should stay with him to the very last?"

RALEIGH—"How was that?"

COOK—"He was operated on for the removal of a pearl which he had accidentally swallowed while eating oysters, and when the pearl was examined it was found to be valuable enough to pay for both the operation and the funeral."—*Tit-Bits.*

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FRENCHMAN INVENTS NEW TORPEDO

SOME highly interesting experiments were recently carried on in the harbor of Antibes, France, with a new auto-dirigible torpedo, the secret of which is guarded with the utmost care. It is only known that this torpedo is driven by means of electric storage batteries, carried in a compartment located under the torpedo proper. The upper part of the device which shows above the water carries two small masts, which act as antennae of a wireless telegraph system. By a suitable connecting mechanism, the Hertzian waves acting on these feelers are transmitted to two governors, and likewise to the battery of accumulators, so as to provide for the starting and stopping of the device, and to produce the explosion at what is considered the fitting moment.

A man-of-war can carry three or four of these auto-dirigible torpedoes, placing them in the water at the point of attack, and start these terrible weapons scouring the sea in the vicinity. They become all the more terrible from the fact that their length does not exceed six feet, rendering them almost invisible to the enemy—they travel at high speed, and their sudden attack serves all the more to dismay the crews of the enemy, whose nerves are kept strung to high tension by the possibility of entirely unforeseen danger.

THE NEW AUTO-DIRIGIBLE TORPEDO IN TEST AT ANTIBES.

HOW KING EDWARD TRAVELS

HEREWITH is illustrated the new saloon train recently built for the use of the King of England. It is constructed of teak, with a steel underframe.

Beginning at one end, the saloon is divided as follows: Entrance balcony, smoking room, day saloon; combination bed and dining room, dressing room, attendant's compartment.

The balcony is panelled with richly figured teak and has a white panelled ceiling. The smoking room is 10 feet long and decorated in Jacobean style. The walls are of oak inlaid with boxwood and dark pollard oak. The furniture consists of two armchairs and a large settee, upholstered in reindeer plush hide. The fittings are of oxidized silver. The day saloon, which is 17½ feet long, is in Louis XVI style, and the walls are of highly polished sycamore inlaid with trellis lines of pewter and light mahogany. The furniture, which is of light French mahogany inlaid with pewter and box, upholstered with silk brocade, consists of two arm-chairs, a large settee and four smaller chairs.

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There is also a writing table which is fitted with adjustable shaded electric lights. The use of pewter is a revival of an old French method, which has a very pretty effect in conjunction with mahogany.

Both the day and smoking rooms are lighted by rows of tubular electric lamps, concealed behind the cornices on each side, giving a very soft and restful light. There are also corner brackets in the smoking room, and handsome gilt wall brackets in the day compartment, the lights in the latter being shaded with hand-painted silk screens.

The combination bed and dining room is 14 feet long, and the walls are panelled and enamelled white; the furniture being in mahogany inlaid with kingwood, and covered with fine old rose colored silk damask with green silk embroidered cushions. When used for day journeys the bed is taken out and the compartment is converted into a dining room. The dressing room, which is 8 feet long, is panelled and enamelled white.

WRITING TABLE IN KING EDWARD'S COACH.

Next to the dressing room is the lavatory, the floor of which is covered with

ONE OF KING EDWARD VII'S NEW TRAVELING COACHES.
View in saloon.

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inlaid cork parquet flooring, and the walls are of fine Italian Cippoline marble cross-banded with white statuary marble. The attendant's compartment is fitted up with electrically heated kettles, urns, etc., and a switch board for controlling the lighting and heating of the carriage.

In order to give uniformity of effect the whole of these rooms, with the exception of the attendant's compartment, are carpeted alike with a fine plain Saxony old rose carpet, and all curtains and blinds are of soft green silk with white silk embroidery.

In addition to electric radiators the saloon is heated by means of warmed air, which is delivered into the various compartments through ducts from electric blowers situated in the attendant's compartment. Ventilation is also afforded in the same way, and the air from the roof ventilators is extracted by means of electric exhausters.

In addition to the saloon for the King, two special saloons have been constructed for his suite and friends, which are vestibuled on to the royal saloon. The partitions are so arranged that each of the saloons can be made into four bedrooms.

WOODEN GUN FORTIFIED WITH LEATHER.

A WOODEN RIFLE WOUND WITH ROPE.

STRANGE MODERN CANNON

WHEN the Americans gained the Philippines, after fighting first the Spaniards and then the Filipinos, they found, in the possession of the natives, some very interesting modern cannon. Though modern—that is to say, of recent manufacture—they were extraordinarily primitive; such cannon, in fact, as might have been built experimentally in Europe during the Middle Ages, at the time when gunpowder was newly invented. Some of them were made of logs hollowed out and wound with many yards of hempen rope. Others were of wood, likewise, but covered with leather to keep them from bursting when fired.

It seems almost unbelievable that cannon so primitive could be made for war purposes in these later days. But doubtless the Filipinos have many like them in their possession still—just such as those shown in the accompanying

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GIGANTIC TELESCOPE AT TREPTOW, NEAR BERLIN.
It has a length of about 70 feet.

photographs of guns captured by the American troops during the war of conquest which the United States was compelled to wage in the archipelago.

NEW EYE TO STUDY THE SKIES

AT the new astronomical observatory at Treptow, near Berlin, Germany, the gigantic telescope shown in the accompanying photograph was recently installed. It has a length of about seventy feet, and presents the appearance of some huge, newly improvised coast defense gun.

TREES UNITE AS ONE

ANOTHER freak tree has come to the fore. Three miles out from the little city of West Newton, Pennsylvania, stands the original of the freak white oak tree shown in the photograph. The straight trunk of this tree stands on the farm of Mr. Christopher Pore, while the curved trunk is planted in the public road. Tradition has it that the Indians once either fastened two oak saplings together at the top, or bent a single sapling double and inserted the top in

Oak Saplings That Have Grown Together.

the ground, in order to form the framework of a wigwam, and that the parts eventually grew together in the form shown. The tree seems to be perfectly sound, and the "oldest inhabitant" can not remember the time when it was not there.

WATER CONTROLLER FOR IRRIGATED REGIONS

THE control of the supply of water upon farm lands, its distribution at will and at the season when its need is greatest, is claimed as a discovery by the irrigation promoters of the West, and there seems to be something in their claim, when the facts of big crops are considered.

HUNTLEY HEAD GATES, 10 MILES EAST OF BILLINGS ON YELLOWSTONE RIVER.

It is difficult to convince the farmer of the humid states of the possibilities of rich soil, where there is an abundant water supply and where the application of the water is controlled. It is, in effect, the prevention of drought, the control of the rainfall, the clouds and the seasons. When the difficulties of the average farmer have been removed there is one great advantage enjoyed by the irrigator over his brother who relies upon rainfall. This is in the fertilizing value of the water from the stream which is fed by mountain snows and springs. The water used for irrigation always contains more or less solid material both in solution and suspension, a considerable portion of which is composed of fertilizing elements. So the process of irrigation always adds more or less fertilizing material to the land, and in many parts of the world, this has been found, year after year, and century after century, to meet the needs of the most intensive farming. When this is understood and the further fact that the fertilizing element in the soil of irrigated regions is not dissolved and carried away by excessive rains, as in the humid regions, explanation of the value of the former need not be sought farther.

The photograph reproduced herewith shows the control gates on the irrigation canal of one of the important projects in the valley of the Yellowstone River. Here the waters are controlled entirely at the will of the operators and at the needs of the land over which the system operates. A recent record from this immediate region is interesting. Alfalfa produces from five to seven tons per acre from three cuttings, and on account of its forage value is one of the most important and valuable crops known, and also because it is used like clover and peas as a crop in rotation with grain or sugar beets, to restore the fertility of the soil. Billings, Montana, is one of the greatest primary fat sheep and wool shipping points in the world. There is at present an extensive free range on both sides of the Yellowstone River which is utilized by many stockmen. Large yields of grain are common in this valley where proper rotation of crops is observed. After plowing up alfalfa land, a yield of ninety to one hundred bushels of oats per acre, weighing forty to forty-five pounds per bushel, is not uncommon. New oats bring about ninety cents per hundred pounds, the price often rising to $1.50 in the spring. Seed oats are now selling for about $1.75 to $2 per hundred pounds.

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THE FASCINATION OF THE MOTORCYCLE

By EARLE L. OVINGTON

President Federation of America Motorcyclists.

MENTION the motoi-cycle and the average individual has in mind a machine making a noise like a gatling gun, surmounted by a rider clothed in leather and covered with dust from head to foot.

Yet the motorcycle does not need to be noisy nor the rider an object of contempt. There are machines on the market today that cannot be heard when fifty feet away, and the tan colored cravanette suit, that does not show the dust, may replace the hideous leather garment.

In the last two years the motorcycle has been brought to such a high state of perfection that it is now one of the most reliable and convenient means of locomotion. It offers the cheapest and most rapid means of covering modern distances, while as a sport motorcycling takes first place, not only on account of the wonderful exhilaration produced by moving rapidly through the air without muscular effort, but on account of the fascination of the little two-wheeled vehicle itself.

Some extraordinary speed records have been made on the motorcycle.

One hundred miles, including three stops, in 97 minutes 59 3-5 seconds, ridden by Jake DeRosier on a motorcycle at Los Angeles, April 18, is one of the most extraordinary performances ever seen, and there are few if any records equaling it by any power propelled vehicle. The entire distance was made on one machine and one stop was necessary to replenish the supply of gasoline and oil, while two other stops were made on account of the physical suffering of the rider, the whole amounting to probably three or four minutes of the total time.

DeRosier made an easy start, and did not take the lead until nearly 20 miles were ridden, but from that point to the end of the race he was never headed, and most of the miles would probably be found to be world's records, as well as the 100 miles, if the scoring was properly recorded.

The first hundred-mile race ever ridden in America was at Philadelphia on October 10, in which Kellogg, riding under adverse circumstances, on a soft dirt track, covered a distance of 100 miles in 125 minutes 5 4-5 seconds. The second race of this distance was won by Robert Stubbs at Birmingham, Alabama, in 107 minutes 44 seconds. This was also, like the previous one, ridden on a flat dirt track.

But probably the average individual would not care to race.

THE MAN IS PART OF THE MACHINE.

AUTOMATIC ELECTRIC CROSSING GATE NEAR MONTREUX, SWITZERLAND.

NEW AUTOMATIC CROSSING GATE

By J. B. VAN BRUSSEL

NEAR Montreux, in Switzerland, upon the Montreux - Berne-Oberland electric railway line a new automatic gate was recently installed. The device is so designed that when a car approaches the crossing, electrical apparatus lowers the barriers across the roadway, and when the train has passed raises them by an inverse action of the mechanism. Thus there is no need for a watchman at the crossing, for the apparatus gives the required security while less expensive to maintain.

The apparatus was first designed for lines using an overhead trolley. However, with modifications, the device can be also applied to steam railroads, providing a source of current is available at the crossing.

The barrier itself is a long pole lowered across the roadway. A vertical channel-iron carries on the cast-iron bracket all the driving mechanism, including the motor, resistance coils and rheostat. The motor drives a large gear-wheel fitted to a conical drum with a spiral groove for winding the cable. The end of the shaft serves as the suspension point for one end of the cable, which passes around the pulley on the horizontal bar. Below and parallel to the axis of the drum is a spring brake.

The near end of the barrier bar which carries the counterweight is made of channel iron, while the barrier itself is a timber of light pine treated by creosoting. The counterweight is a cast-iron frame made to hold different iron weights for balancing bars from ten to thirty feet in length. At the pivot of the bar is a drum on which is wound a cable which crosses the track over a set of pulleys and operates the swinging bar on the other side of the track. To protect the driving mechanism from the weather it is covered by a light housing which can be readily removed. Incandescent lamps and an electric bell are used as visible and audible signals. The current is supplied through the contact of the bow trolley with an auxiliary wire.

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HOW A PLOW WAS USED TO DIG UNDER WATER.

PLOWING A WATERWAY

By M. M. HUNTING

THE expense connected with excavation in the forming of canals and other waterways has always been a tremendous obstacle in the way of the engineer attempting such work. In northern Colorado, however, an innovation in the way of canal cutting was recently introduced. An outlet to Boyd Lake reservoir was required, and the engineer in charge, Mr. C. B. Greeley, took advantage of the submerged plow idea together with running water, and not only was the outlet very successfully completed, but the cost of the undertaking, which would have been prohibitive by any other means, was reduced to about one-fourth the cost by other methods.

The work was started by first digging two trenches one rod apart, each trench being about four or five feet deep and thirty inches wide. A pole forty feet in length was then mounted upon two wagon wheels and to each end of this pole, upon opposite sides of the trenches, teams were hitched for the purpose of drawing a plow attached to the center of the pole and set in the ground between the two trenches.

As soon as the surface earth had been loosened, water was turned on from the upper end of the outlet, and immediately the free earth was carried by the swiftly moving water toward the opposite end of the trench. The plowing was continued until the entire core or the ground between the two trenches was carried away and deposited upon the bottom land over which the water flowed.

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View inside the Completed Tunnel.

The course of the plow was controlled by ropes fastened to the handles of the plow and held in position by two men stationed on opposite sides of the ditch. As the ditch deepened, the bed became uneven, and a spring-tooth harrow was substituted as the occasion demanded and did excellent service in leveling the bed.

The water, which during this time was the means of carrying away the loosened earth, did double duty, for it not only acted as transport for the escaping dirt, but was sold to the owners of the surrounding bottom lands for the purpose of irrigation. In this way a snug source of income was realized and this revenue helped in defraying the expense of the project, as the price obtained was $7.00 per day per second foot, or about $80.50 per million cubic feet.

The loose earth carried off by the water over the bottom land improved this ground immensely, as it served for the filling of hollows and the general leveling of the entire section. The canal in all is about two miles long and extends through very valuable farming land and it was greatly to the advantage of all concerned to carry the material out by sluicing and deposit it where it was needed, instead of piling it upon the banks of the cut to the great injury of the land adjoining.

The cut is connected to Boyd Lake reservoir by a concrete tunnel three hundred feet long. This tunnel is thirty feet underground and was a very difficult piece of engineering work, as it is under heavy gravel which at the time was filled with water. At the head of the tunnel is a concrete headgate tower thirty-eight feet in height. The gate itself is equipped with bronze roller bearings and when closed shuts the water out of the tunnel and the valve chamber also. The illustration shows a flashlight photograph of the tunnel just before it was accepted by the owner, Mr. B. D. Sandborn of Greeley, Colorado, from the contractors. The tunnel and equipment cost in all about $17,000.

When the sluicing of the waterway was commenced, the lake in question had a water surface of three and one-half miles long and one mile wide. After two months of sluicing the water lowered three and one-half feet, that is to say, about 250,000,000 cubic feet of water passed through the cut.

During the months of July and August the water supply in the streams and reservoirs of Colorado becomes quite low, and the question of water for irrigating purposes would become more or less of a riddle were it not for the streams flowing from the snowcapped peaks of Estes Park. The new tunnel and outlet described above have added greatly to the water supply of the locality and will be the means of transforming into fertile fields what otherwise would remain barren wastes owing to the lack of water.

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INSTRUMENT FOR TESTING HARDNESS

By I. F. SPRINGER

ONE of the most important of all metallic properties is that of hardness. But until the last few years there has been no very reliable method to measure it. True, we have been using files for time out of mind. But even if we grant that the file gives accurate information, we have no means of estimating small differences in hardness. However, of late years, several methods have come to the front. One of the best of these is the process of the scleroscope.

This instrument is the invention of Mr. A. F. Shore. One method of using this device is to mount it on a swinging bracket. The glass tube is open at the bottom. A tiny hammer of exceedingly tough and hard steel fits in the bore. It is pointed at the lower end. The operation of testing a specimen is carried out by placing the metal to be tested below the lower end of the tube. The rubber bulb at the top is used to draw the little hammer up by a sucking action. The hammer is held by a suitable catch until the moment of testing. A hook at the left side near the top is pressed down and the lower bulb is compressed. The hammer is now

INGENIOUS INSTRUMENT FOR TESTING THE HARDNESS OF METALS.

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free to fall and strike the specimen with its point. Of course, the tube should be in a vertical position. Whether this is the case may be determined by a rod

TESTING THE HARDNESS OF METALS.

placed at the right of the tube. It is really a plumb rod, swinging freely from the upper end and free at the bottom. The hammer, though small, strikes its blow with a point so small that the impact is calculated at 75,000 pounds per square inch. This is beyond the elastic limit of most metals. Consequently, the blow struck makes a permanent displacement of metal.

Now when the impact is made there is resistance to it, although not sufficient to avoid permanent deformation. This resistance manifests itself in causing a rebound of the hammer. A scale reading from 0 to 140 is arranged to the rear of the tube, and furnishes a means of measuring the amount of the rebound. In this way a number is obtained which represents the energy of resistance at the moment when the elastic limit is exceeded. This appears to be just about what we mean by hardness.

The base and upright in this mechanism furnish an attractive method of mounting the instrument. Further, the essentials of the device may be totally disengaged from all arrangements for mounting. The scleroscope may then be used with convenience in testing parts of machines without removal. It may be added that the instrument is adapted to test the hardness of metals in general.

It is interesting to note the degrees of hardness shown by various metals—and indeed by the same metal under different conditions. Thus lead causes a rebound of but 2 spaces. However, hammered lead has a hardness of 3. Babbit metal varies from 4 to 9 or 10. Copper, uncompressed is 6 hard; but compressed, its hardness rises to 14 or even to 20. A gold coin, which of course is compressed, shows a hardness number of 14. Wrought iron in the ordinary state has a hardness of 18, but by compressing its particles its hardness may be increased to 30. It is then about as hard as annealed railway rails. Tool-steel when properly annealed discloses a hardness sometimes as low as 31. But cold-rolled in the form of drill-rod it may rise to 35 or 40. Hardened tool-steel varies between 90 and 110. Porcelain gives 120 and glass 130. This latter is pretty close to 140—a rebound equal to the fall.

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STILT WALKERS OF LES LANDES

By FRITZ MORRIS

THE children whom we see running about on stilts, and who consider their ability to do so a rare accomplishment, will be surprised to learn that there is a vast district in France where the entire community moves, goes about, and transacts its business on stilts. This district is called "Les Landes," a name given to it because it is nothing more than a vast sandy plain unsuited for cultivation and quite incapable of bearing grain. In point of size, it is the third department in France and it lies to the north of the river Adour. Strange to say, the whole country to the south of that river is fertile. The Landes are thinly populated, and the inhabitants, who are among the poorest peasants in France, gain their subsistence by fishing, by such little agriculture as is possible, and by keeping cows and sheep. The shepherds made use of their stilts for two purposes, first, because walking is quite impossible on account of the sage and undergrowth of brush, and because the height of their stilts gives them a greater range of vision. From their elevated position they can watch their flocks for many miles because the land is absolutely flat. The stilts have a head something like a

A CURIOUS MODE OF PROGRESSION.

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SHEPHERDS WITH THEIR FLOCK.

crutch and, when fatigued, the shepherds use this as a comfortable seat, and while away their time in knitting.

The stilts generally are about six or seven feet high, and near the top there is a support for the foot which has a strong stirrup and strap, and still nearer the top a band of leather fastens the stilt firmly to the leg just below the knee. Some stilts, especially those made for fancy walking, and for tricks, are even higher than seven feet, and the man who uses these, and he must be an expert, can travel as fast as ten miles an hour. The lower end of this kind of stilt is capped with a sheep bone to prevent its splitting. The old shepherds, gaunt looking, and wearing shaggy, sleeveless sheepskin coats and gaiters, and the cheret, a sort of Tam-O-Shanter hat, pass their entire days from dawn until dusk, mounted on their perches. They are often accompanied by their wives and their children, and sometimes by their grandchildren who use a stilt about three and a half feet in height.

Some of these Landes shepherds are most wonderfully clever in the management of their stilts. They run races, step or jump over brooks, clear fences and walls, and they are able to keep their balance and equilibrium while stooping to the ground to pick up pebbles or to gather wild flowers. They fall prone upon their faces and assume their perpendicular without an effort, and in a single moment after they have thus prostrated themselves.

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TIDE-WATER MOTOR IN POSITION.

TIDE-WATER DEVICE IS EFFECTIVE

By A. B. STEARNS

A TIDE-WATER device different from anything heretofore originated, and yet so simple that it is strange it was never tried before, is the invention of a Massachusetts man, John Hall, who has been working upon this scheme for over fifteen years. He stumbled upon the idea of using rising water to compress air while watching the effect of a rain storm. The sewers were flooded. Suddenly one of the man-holes blew up and a short time afterward the water came rushing to the surface. Mr. Hall wondered why the water did not follow just as soon as the man-hole blew up and concluded there must be a volume of air in the upper part of the sewer, and compression of this air caused the explosion. Following out this principle he constructed his tide-water device.

It is an inverted tank securely fastened down with the lower end open and below low water level. When the water rises around this tank it compresses the air inside and this compressed air is utilized in running an engine. When the space in the tank is filled with water a shut-off is automatically closed and another tank is opened, and so on.

When the tide goes out and the water recedes from the tank it leaves a volume of water inside the tank held by the vacuum at the top of the tank. This vacuum is a wonderful power and never before has such a use of it been made as in this instance. So powerful is it that a tank constructed to hold it will collapse unless securely built and strongly braced on the inside. The top will have the weight of the entire body of

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water hanging as it were from the inside and when the pipe is opened this tremendous power is at once available to run the engine.

Broadly considered, the invention consists in providing an inverted tumbler-shaped member, the open end being downward for receiving the inflow of water, the upper portion of this cylinder having connected thereto a pipe for conveying the compressed air to a suitable motor. It is understood that during the ebb tide a vacuum will be produced in the inverted tumbler-shaped member whereby the motor may be operated as a vacuum machine. In the drawing may be seen the tumbler in an inverted position with weights to hold the same in position against any movement, and also is indicated in conventional form a motor with suitable pipe connections between the valve-chest of the motor and the upper portion of the cylinder. *A* designates the inverted tumbler, the lower portion of which is embedded in a block of concrete or other suitable material for providing a firm foundation for the tumbler. *C* designates openings for permitting the water to enter the interior of the casing. *D* designates piles driven into the bed of a body of water and these are connected at the top by timbers or other framework. *F* designates the weight upon the top in the drawing, rocks and stones. The upper end of the casing *A* is threaded for receiving an outlet pipe *G*, that is provided with a shut-off valve *H*, and leading from this valve is a pipe *I*, that extends to valve chamber *J* of motor *K*. The low water level is indicated at *M* and the high water of flood tide at *O*. Although the drawing shows only a single inverted cylinder it is evident that any number of them may be employed with suitable pipe connections leading from one to another, whereby the combined effect of several cylinders may be obtained for operation of the motor.

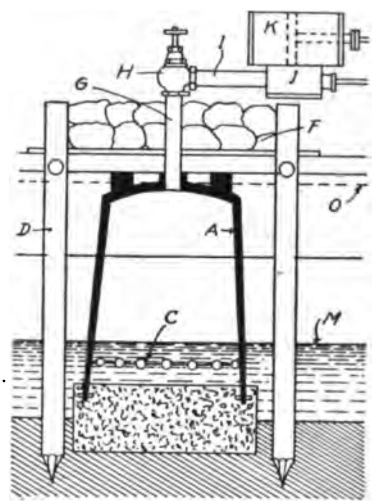

Diagram Showing Working of Tide-Water Motor.

Referring now briefly to the operation of the device. It should be understood that the shut-off *H* is closed when the water is at low tide and as the water level rises in the casing, the air confined there in the space between low water and the top of the casing will be placed under pressure, the degree of which being determined by the amount that the water rises. Admission to the interior of the cylinder is, as is readily understood, through the opening *C*. When the water reaches the level indicated at *O*, the shut-off valve *H* is opened, allowing the compressed air to flow through the pipes *G* and *I* to the motor *K* for operating the same. The motor will continue to run as long as the pressure of the air within the casing is greater than the atmospheric pressure and after the two pressures are equaled the valve *H* is closed, and when the water recedes or falls back to low tide, a vacuum is thus produced inside the casing. Upon opening the valve *H* again the motor can be operated as a vacuum machine, the vacuum in the cylinder causing a difference of pressure on the other side of the piston whereby the piston will move under the difference of pressure as is readily understood.

There seems to be no limit to the size of the air chambers, and once the cost of constructing them is defrayed there seems to be no further need of attention. There will be no coal to burn, and a watchman will not be required. The period between the high and the low tide can be provided for by the installation of reserve tanks placed at different heights and in this way the motor can be operated during the whole twenty-four hours of the day.

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CARGO ON CLIFF READY TO BE SENT ON SHIPBOARD VIA WIRE.

LOADING LUMBER BY WIRE

By M. D. A. CYVIL

THE mouth of the Russian River, in Sonoma County, California, is closed every year by the sand bar, piled high and dry by old Ocean's breakers, and forming a perfect natural dam. The river waters back up until, at Genner, the sounding line shows five fathoms. The mouth of the river closed, the lumber market was closed to Genner. To meet this emergency the mill owners built a wharf at Markham, two miles above Genner. During the deep water season the lumber from Genner was hauled up to the wharf on a gasoline barge, and there loaded on cars for shipment, via Duncan Mills. This method was far from satisfactory—lumber was high and in great demand, rates were exorbitant, and cars at a premium. For some time these obstacles had been noted and another outlet for their product had to be found. The only way to get a better service was to put the lumber in the "bottoms" as they lay anchored on the ocean swell, near some convenient bluff, and the only way to get the lumber from the mill to the ship was trolleywise. "The Chutes" was conceived.

About three miles north of the Russian River at Russian Gulch, the Chutes was built. The lumber company operating here took no chances, and though it shipped the bulk of its output by railroad, at the same time it experimented with these "Chutes," and found

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THE CAR LOADED.

results satisfactory. Consequently three years ago when the aquatic pranks of this "River of Tragedies," during the spring flood, tore out the county bridge, and left only four or five piles to mark where the lumber company's wharf had stood, the mill owners thanked themselves for this rainy day provision. The lumber is hauled from Genner to Russian Gulch, where the Chutes stand, by the railroad—standard gauge roadbed, standard flat cars, and a respectable engine. There are about six miles of railroad.

The Chutes proper consists of an inch steel cable, strung from a powerful donkey engine out to the boom of the loading vessel, and a car. The schooner stands about eighteen hundred feet from the shore and is held in place by mooring lines, strung to three piles, two on the port side, one forward, the other aft, and one amidships on the starboard. The mooring lines are thus the bisectors of the three angles of a triangle. The car is a three-foot square frame, and encases three sheaves—two above for trolley runners, and one below for the "hoist" line.

A loaded car is run upon the turn table in the shed, directly under the trolley car. The lower horizontal bars are placed under a thousand feet of lumber, a load, and fastened on each side. At a given signal, the cable car and load are lifted, the haulback released and away shoots the car on its eighteen hundred foot journey. The bluff on which the Chutes stands is three hundred feet high. Some idea of the acceleration can be had from the fact that it takes a loaded car just two minutes to make the round trip. One of the ordinary coasting schooners is loaded in less than two and one-half days. If you want to "shoot the chutes" with a vengeance just get on a load of lumber at the "Chutes" in Sonoma County. The writer is sorry that he did not grasp the opportunity when it presented itself.

THE CAR DANCES ALONG HIGH ABOVE THE WAVES.

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JAPANESE TRANSPLANTING RICE AT DEEP-WATER. TEXAS.

JAPANESE RICE FARMERS IN TEXAS

By W. D. HORNADAY

THE Japanese rice farmers in Texas are rapidly getting rich. There are several prosperous Japanese colonies in that state, the largest and most notable being the ones at Webster and Deepwater. It is estimated that there are about five hundred Japanese farmers in Texas. Most of them are rice growers. The first Japanese colony in Texas was established about six years ago. It was found that the lands situated adjacent to the Gulf coast of that state are especially suited to rice growing, and the success of the original colonists in this industry led to the establishment of other colonies of Japanese at various points in the coast territory.

The rice crop in Texas for the year 1908 amounted to about two million sacks. Each sack contains four bushels. The price per sack ranged from $3.25 to $3.75. The yield per acre was the most abundant ever known. This was particularly true of the farms operated by the Japanese. Many of the Japanese planters harvested from two hundred to three hundred acres of rice, the gross revenue which they derived from the season's crop being from $100 to $125 per acre. Owing to the different methods of planting and cultivation followed by the Japanese, they obtain a much larger yield of rice per acre than American rice farmers. In many cases this last season the yield per acre of the Japanese farms was double that of other farms in the same locality.

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JAPANESE THRESHING RICE.

It is stated that the Japanese farmers of Texas are doing much towards developing the natural resources of the coast territory. They are hard workers and usually get all there is to be had out of the soil no matter what the crop is. They have set an example for many American farmers of that region which promises to bring good results.

Aside from their marked success as farmers, the Japanese colonists in Texas are said to be good citizens in all respects. During the rice havesting seasons the Japanese planters employ hundreds of men upon their farms. Many of these field and harvest hands are negroes. They pay the same scale of wages that are paid by the American rice farmers and are even more kind and liberal in the treatment of their employes than the average native farmer.

The rice harvest season is a time of great enjoyment among the Japanese. They help each other in the threshing and in marketing the product. They co-operate in many things, and each farmer apparently wants to see his Japanese neighbor prosper to the greatest possible degree. These Japanese have found rice growing such a profitable business that many of them who came to this country only a few years ago with a few hundred dollars as their sole available capital are now the owners of big tracts of rice land, worth all the way from $10,000 to $100,000.

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TECHNICAL WORLD MAGAZINE

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Tiny Scourge of the World

By HENRY M. HYDE

Who Gets to the Top?

By SAMUEL O. DUNN

Struggling for the Air

By FRANK DOIG

Just Junk!

By CHARLES DILLON

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HENRY M. HYDE, EDITOR

CONTENTS FOR AUGUST, 1909

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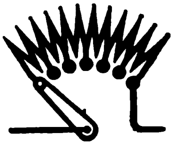

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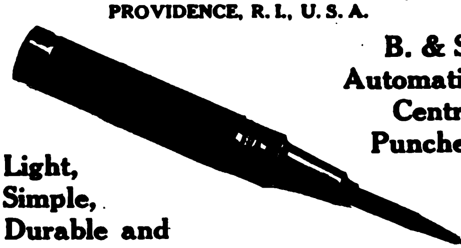

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Mr. Parker on November 1, 1903, after having been a member of the Examining Corps of the U. S. Patent Office for over five years, resigned his position as Examiner to take up the practice of patent law.

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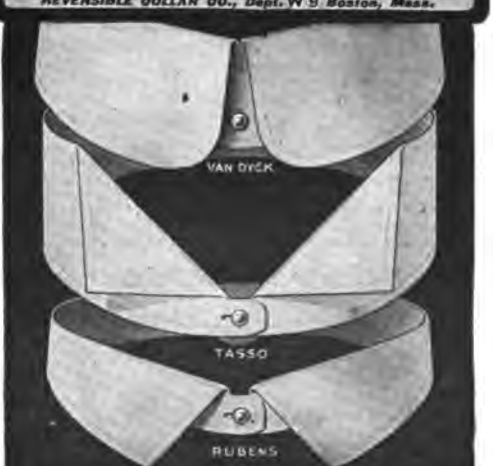

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Tech. World, 8-'09

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Scene at entrance to the Chicago River.

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For article see page 62[illegible]

THE TECHNICAL WORLD MAGAZINE

Volume XI. No. 6

AUGUST, 1909

MAKING GOVERNMENT GOOD

By C. F. CARTER

WHY is it that a man working for a private employer can accomplish more than eleven times as much in a day as a man doing precisely similar work for the city? And why should work done for the city cost fifteen times as much as the same quantity of the same kind of work done for a private employer?

Why should the city pay a clock repairer $11.63 per hour for tinkering at its clocks? Why not save money by throwing away a clock as soon as it got out of order and buying a new one?

Why is it that the city is obliged to pay sixty cents each for common wardrobe hooks and five cents each for two screws to put up each hook, making the total cost of each hook seventy cents, when the plain citizen can go into any hardware store in the land and buy the same kind of hook with the screws throw in for six cents? And why does it cost the city an additional $1.51 to put up each hook, making the grand total cost $2.21 per hook?

Why does a given quantity of rubber hose that costs other purchasers $196 cost the city $500?

Why do gas mantles retailed everywhere at twenty cents each cost the city forty cents when purchased in quantities?

Why do brackets retailed at forty-five cents cost the city three dollars?

Why did ground with an assessed valuation of $4,300 cost the city $247,053 when bought for park purposes?

Why does it cost the city $8.25 a load to haul dirt when a private citizen can get it hauled the same distance under identical conditions for $1.47 a load?

These are sample conundrums from rather a long list propounded at the first budget exhibit of the Bureau of Municipal Research, which was held recently. In reality they were aimed at a specific city, the metropolis of a well known English-speaking nation of North America; but as fate would have it the conditions outlined in the conundrums depicted with startling fidelity the situation in about every community in the land big enough to be afflicted with a municipal government. Finding the shoe fitted, cities everywhere proceeded to wear it.

The result, totally unexpected, though the Bureau of Municipal Research now tries to let on that it did it on purpose, was the most extraordinary national awakening to the imperative need of im-

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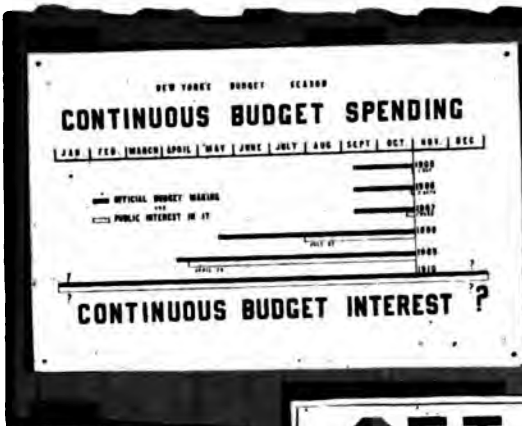
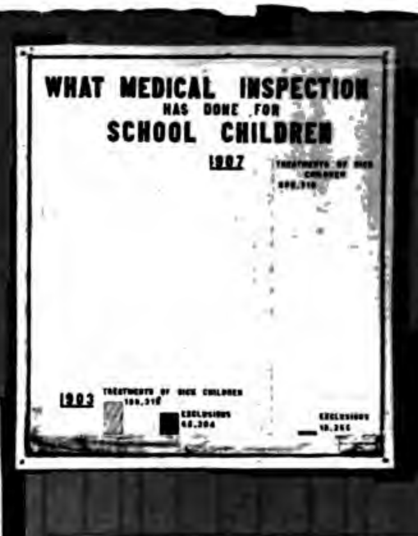


WHO CARES ABOUT THE OLD BUDGET, ANYHOW?



HOW GOOD WORK BY THE HEALTH DEPARTMENT WAS PROVED TO THE PUBLIC.

WARDROBE HOOKS COME HIGH, BUT THE CITY MUST HAVE THEM.

mediate, sweeping permanent reform in the administration of municipal affairs that this country has ever known. In New York, Philadelphia, Cincinnati, Memphis and Atlanta the work of improvement is already under way; in Boston, Buffalo, Cleveland, Los Angeles, Louisville, Minneapolis, Pittsburg, San Francisco, Seattle, and Spokane preparations for it are making, while many other cities fidgeting on the anxious seat are imploring the Bureau for information and help.

All the fun of asking conundrums lies in the privilege of furnishing the answer. Of course the Bureau of Municipal Research had all the answers to its posers ready. Like all other conundrums the answers in this case are so ridiculously simple that they excite what the psychotherapists probably would call "auto-resentment," which may be defined as a desire to kick one's self. By adopting methods suited to the mental limitations of the kindergarten the Bureau of Municipal Research has driven into the comprehension of the taxpayers and clinched there the tardy realization that the key to all corruption lies in the budget.

Heretofore all attempts at reform have been predicated on the theory that all that was necessary to obtain relief from the endless round of waste, neglect, indifference, incompetence, extravagance and corruption was to elect a Democrat or a Republican or an Independent or a Non-Partisan, or an Honest Man or a Business Man or Something. But it has invariably happened that the corruption continued to increase under the reform administration and the last state of the city was worse than the first.

If he can but make the budget the grafter cares not who is elected. For it follows that if money is appropriated it will be paid out, however great the difference between the ostensible and the real purpose for which payment is made; whereas, money not asked for and granted with all becoming formalities must remain in the treasury. In pointing out these obvious facts the Bureau of Municipal Research has given the

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Disgraceful Paving Conditions In New York City.
The Board of Municipal Research is changing this.

gentle guild of grafters the only real setback it has ever received.

For the first time in history the practical politicians of New York sat in the background this year looking on in helpless rage while a lot of folks who have heretofore been satisfied to limit their civic functions to paying their taxes and grieving about them at the club indulged in the novel pastime of spending their own public funds as best suited them.

For the first time in history a tentative budget has been submitted to the New York public in terms so plain that it can actually be understood. Department heads have been obliged to prepare at the time required by law itemized estimates of the sums they want in 1910 showing precisely what they want each dollar for and why they want it. This time the tentative budget was not locked up to be inspected in secret by interested parties only and then to be rushed through at the last moment, but was given to the public to be analyzed, criticised and investigated.

All sorts of meetings, conferences and consultations have been held to overhaul these estimates. Even the women have taken a hand in the game. They said they paid their share of the taxes and they proposed to see that the money was not wasted. By the time they all got through the pickings were so lean that a lot of prominent politicians are preparing to go into other business. Tammany has lost interest in the coming election and the Republican organization doesn't care whether school keeps or not. Why, a church member could be elected mayor of New York this fall. No matter who is elected the city is sure of getting more for its money than it ever got before.

As this outline of changes wrought can be made to apply a year hence to any one of a number of cities by merely substituting another name for "New York," the means by which the transformation was wrought becomes of more than ordinary interest. The Bureau of Municipal Research was organized in 1906 as the "Bureau of City Betterment." With a fund of only twelve thousand dollars to work with the Bureau succeeded in making so many grafters unhappy that it attracted attention, was incorporated under its present name and provided with a fund of $42,000 for its second year and of $91,000 for its third year's work.

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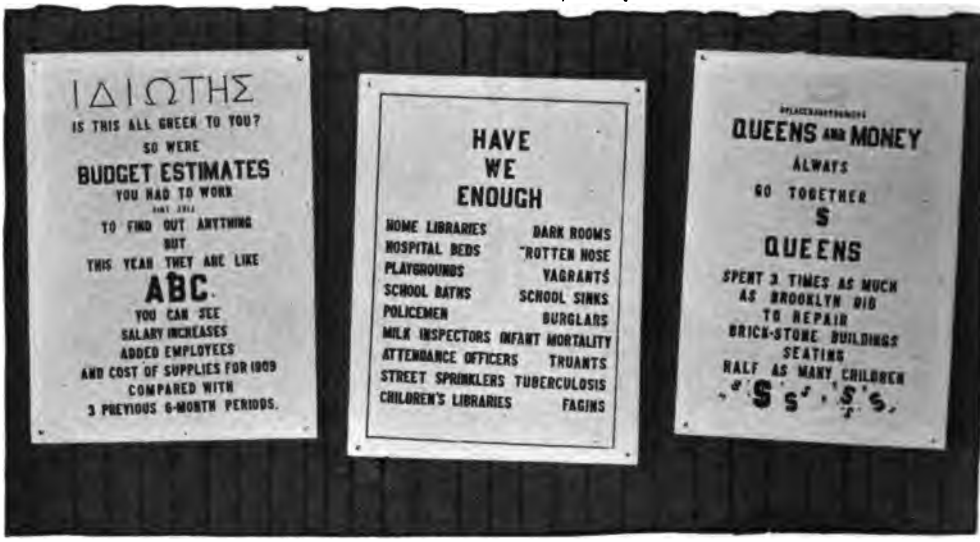

SHOWING WHAT THE BUREAU OF MUNICIPAL RESEARCH HAS DONE.

NO. BUT THERE'S NO LACK OF SOFT SNAPS AND GOOD THINGS.

THIS WAS MEANT TO POINT OUT WHERE THE GRAFTERS HAD FOUND A GOOD THING.

The working machinery of the Bureau consists of three directors, W. H. Allen, Henry Bruere and F. A. Cleveland and a staff of employes; but it has the enthusiastic moral and financial backing of R. Fulton Cutting, who contributed $20,000 to its support this year, of John D. Rockefeller and Andrew Carnegie who each gave $10,000 and of Henry Phipps, R. C. Ogden, John Claflin, Robert W. De Forest, E. R. A. Seligman, F. A. Vanderlip and many others of that stamp who contributed lesser amounts in cash and unlimited encouragement.

With such backing the Bureau has been able to score a long list of achievements for the general good, of which the following are samples:

Caused the removal of one borough president on charges of gross incompetence;

Frightened another borough president into precipitate flight;

Started an investigation of another borough president;

Caused the removal of the senior commissioner of accounts;

Caused the removal of the commissioner of public works;

Caused the removal of the commissioner of street cleaning;

Caused the removal of the superintendent of public buildings;

Caused the removal of the chief engineer of the bureau of highways;

Caused the removal of a miscellaneous assortment of smaller fry;

Focused the limelight on two borough appropriations which made them shrivel a million and a quarter;

Investigated most of the municipal departments.

That little overworked word "investigate" in this particular instance happens to mean a great deal. To cite a single instance, one of the bureaus investigated was the city water department. This department has been running along in the same old way for years, just as the water departments of a lot of other cities that could be mentioned if necessary have been running. No one paid any attention to this department, any more than to other departments.

The Bureau found that for nearly two years before it turned the limelight in that direction forty per cent of the water meters had been read continuously by the same inspectors who had books showing the conditions of the meters for a long period. Hence, if an inspector had a poker game or other urgent business on hand he need not make his rounds at all since he could fix up his books in a few moments in the back room of the nearest saloon.

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SURELY THE CITY CAN'T COMPEL PEOPLE TO BATHE IN WINTER. CAN IT?

IF ALL LANDLORDS WERE ONLY LIKE THE CITY OF NEW YORK!

WORKING THE DEADLY PARALLEL ON THE GRAFTER.

Here is what the Bureau found on some of these soft snap beats:

At 48 Delancey Street, recorded as a dwelling, was a stable with twelve stalls in the basement, all in use. No. 321 East Sixty-third Street, charged as a dwelling, contained eighteen stalls, fifteen of which were in use. Nos. 2388-90 Broadway which was charged fifteen dollars frontage rate and ten dollars on other counts, had two gas machines and three large washing machines in use. No. 613 West Forty-ninth Street, charged as a stable, contained four stalls and a scouring and dyeing business of the use of which there were ten tubs with water running in a large stream in a gutter down the center of the room. No. 327½

THREE MEN WHO ARE MAKING NEW YORK CITY KEEP HOUSE ECONOMICALLY.
Henry Bruere — William H. Allen — Frederick A. Cleveland

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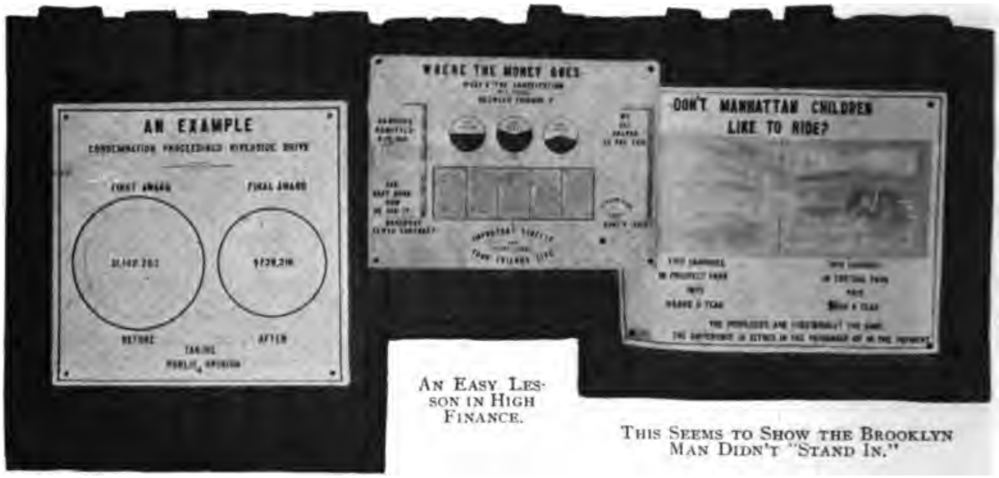

AN EASY LESSON IN HIGH FINANCE.

THIS SEEMS TO SHOW THE BROOKLYN MAN DIDN'T "STAND IN."

HOW EASY MONEY BEGINS TO SHRINK UNDER THE LIME LIGHT.

East One Hundred and Twenty-second Street, recorded as a residence and charged six dollars a year, had ten stalls in the basement and a bottling business on the second floor. No. 232-4 West Eighteenth Street had had no meter readings since January, 1899. The proprietor of the stable containing fifty stalls had no meter but thought there had once been one in the cellar which was now filled in and cemented over. At No. 426 East One Hundred and Fourth Street where twenty stalls were in use the meter had not been read for five years. The meter was knocked over, the dial blank, dial and seal were gone.

Some meters were inaccessible, some were so covered with mud, water and refuse that it was impossible to tell whether they were sealed and in good condition. The meters were put together with screws so that their parts were readily accessible to any one interested in reducing the record.

Of 6,028 meter records analyzed 2,919 were shown to have been in a condition of neglect for an average period of 9.8 months; some had been in a neglected condition for years. One-third of the meters were still in a condition of neglect at the close of the inquiry.

To be sure, the city's interests were not lost sight of by the inspectors who were too busy to make their rounds. When they found time they sat down and "averaged" the charges that should have been made if the meters had been duly read and reported. Of 8,238 meter accounts investigated by the Bureau, twenty-two per cent had been "averaged." Then after the meters had been averaged a lump sum was sliced off the bill so as not to be too hard on the consumer. On one sum of $17,352.30 there had been an arbitrary reduction of $3,726.30. Finally, when the water register got hold of the account he carefully charged up the bill and then accepted as payment in full whatever the water user chose to offer him. The register admitted that in two years bills aggregating $1,800,000 had been "averaged," and that he had accepted as payment in full about $900,000. Yet after this most liberal treatment of the city's patrons the Bureau of Municipal Research was mean enough to say the city had "not only been deprived of revenue, but that the system maintained put a very large premium on inefficiency and dishonesty."

One of the interesting discoveries made was that a considerable number of former employes of the water department were regularly engaged in going about from user to user making a business of fixing meters. It is a very simple matter to "fix" a water meter. By moving a pointer one notch it is possible to cancel a charge of $90.

The result of this particular investigation was a complete reorganization of the water department on a business basis with a resultant increase of a million

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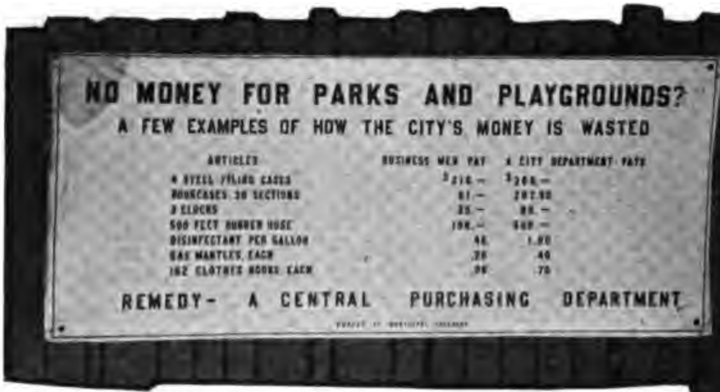

Is It Any Wonder the Budget Is Always Growing?

Making Plain to the Tax-Payer the Fact He Was Paying a Clock-Repairer $11.63 per Hour for His Services.

dollars a year in the revenues of New York City.

Very interesting discoveries were also made in other departments. It was found, for instance, that keeping New York's city hall clean costs the taxpayers $19,707.25 a year. Two men are employed to each three rooms; that is, one man cleans one room and half another, yet no one has ever complained that the city hall was any cleaner than it should be.

Three hundred feet distant from the city hall stands the Park Row building which is owned by private parties, a large portion of which is leased by the city for public offices. In this building janitor work costs $24.13 per room per year, or one-fifteenth of the cost per room of cleaning the city hall. In the Park Row building each employe cleans seventeen rooms per day, or, in other words, he does eleven times as much work as the city janitor, and the building is neat and wholesome.

Learning of this condition of affairs a corporation which makes a business of janitor work in large buildings offered to sign a contract to keep the city hall as clean as it is now kept for one-eleventh of the present cost, or $1,800 a year; and to keep it really clean for $3,600 a year, which is about one-sixth of the present cost. But did it get the contract? Well, not exactly: what do you think Tammany is in business for, any way?

If John D. Rockefeller did business the way the city of New York does he would be bankrupt in three weeks. The West End Hotel in Fort Washington Park, owned by the city, is occupied by a tenant who not only has not paid a cent of rent for seven years, but who has by clever bookkeeping contrived to run up a bill against the city of $1,386.92. A merry-go-round in Central Park pays $600 a year for the privilege of operating in this profitable location, while a similar privilege in Prospect Park, Brooklyn, brings in a revenue of $6,600 a year, and the concessionaire makes money at that.

At a city store yard it was found by the Bureau that no inventory had been taken for ten years. Some stocks were short, others showed a surplus, while still another that had cost $3,000 had not been touched since its purchase five years before. A privilege for a soda water stand that had paid the city $600 a year before the Bureau began stirring up things now brings the city $8,400 a year.

Still another neat little find was, that the street railroads were indebted to the city in the sum of $1,500,000 for paving between the tracks at public expense. Another find was that unpaid taxes amounted to thirty dollars per capita.

To be sure, discoveries of this kind have been made before. They have furnished some first page copy for the newspapers for a day or two and that was the end of them. But the Bureau of Municipal Research did not stop with mere

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It Costs the City an Awful Lot to Keep House.

New York's City Hall Must Be Hard to Keep Clean.

discoveries of sensational conditions. It also showed just why such conditions were possible and how they might be remedied.

Comptroller Metz was so interested in a presentation of the need for more efficient supervision of the department accounts that at his request the Bureau of Municipal Research made an exhaustive study of the department of finance. The Comptroller published the report and reorganized his department along the lines suggested in it. One result has been that warrants that formerly might be held up for three days or three months without redress and without possibility of definitely locating responsibility for the delay are now passed through within one day, or two days at the outside. The slight change in this one division of warrants saves time, saves $25,000 a year in printing and saves $30,000 a year in clerk hire. Voucher and invoice processes were installed on the Bureau's plans which enable the department of finance to receive promptly from all departments the information necessary to place the city on a favorable trading basis, thus getting for the first time the benefit of trade and cash discounts and establishing a full record of liabilities as soon as incurred.

The Bureau compiled convincing proof that the office of commissioner of accounts was simply a whitewashing machine filled with political appointees, many of whom, including at least one commissioner, had engaged in private accounting on the city's time. The office was reorganized on a basis of efficiency that would do credit to any private accounting firm.

A memorandum from the Bureau on the inefficient organization of the bureau of licenses led to a thorough reorganization of that bureau, including the dismissal of officials responsible for graft. Now the bureau is as well conducted as if it were a private business.

Changes in methods of administration in another bureau saved the city $200,000 a year, resulted in the laying of as much pavement in two months as in the preceding two years and marked the beginning of records that give some idea of the work being done.

The Bureau of Municipal Research investigated the board of health, the park department and the tenement house department and made recommendations regarding each of them which have led to notable increases in the efficiency of them all. The grand total of reforms introduced through the agency of the Bureau has given the metropolis better public service than it ever had before and this under a Tammany administration. Results have vindicated in a remarkable degree the Bureau's contention that an archangel could not give an American municipality an honest and efficient administration if old methods were followed; but that if common sense business methods were applied to municipal affairs any sort of man that politics happened to throw up would render satisfactory service for the thoroughly

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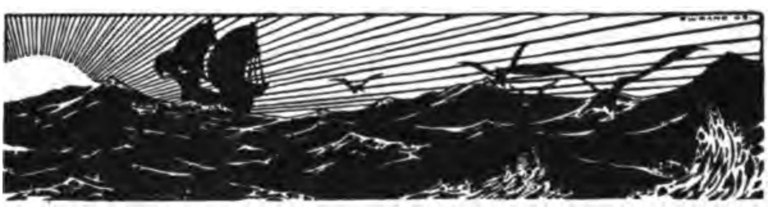
THIS GOES TO SHOW THAT THE BRONX BOROUGH PRESIDENT KNEW HIS BUSINESS.

PAY ROLL PUBLICITY.

sufficient reason that he could not help himself.

Lastly, the reasons for the maladministration, corruption and incompetence were carefully set forth in short lessons in easy words and presented to the public in the first Budget Exhibit together with equally simple and direct explanations of the way in which the public could play its proper part in the management of its own affairs, the principal feature of which was to keep a sharp eye on the budget. Seventy thousand persons visited the exhibit and every one else in New York read about it.

Now the resistless force of enlightened public opinion is behind the Bureau which has given American municipalities the first ray of hope they have ever had for really efficient and economical government in return for the billion dollars a year spent for the purpose.



Why Men Drink

If on my theme I rightly think,
There are five reasons why men drink—
Good wine, a friend, because I'm dry,
Or lest I should be by and by,
Or any other reason why.

—JOHN SIRMOND.

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A MOSQUITO'S SURGICAL INSTRUMENTS.
They consist of a lance and four little saws, with which a mosquito makes and enlarges her puncture.

TINY SCOURGE OF THE WORLD

By HENRY M. HYDE

BZ-Z-Z-BR-BR-Z-Z! Well may the thin-skinned race of man shudder and go wan as that shrill and triumphant war-cry strikes the enlightened ear. It means war, pestilence and famine; it heralds the onslaught of an inconceivable host, armed with poisoned arrows;. it is the rallying cry of a merciless and malignant horde, which slays and spares not—neither the nursing mother nor the babe in her arms. Insomnia, blood-poison, malaria, elephantiasis, yellow fever are its allies; swarming in their billions, its warriors have stopped the progress of agriculture, depopulated whole great regions, ruined nations, overthrown the Roman Empire. In the United States alone, the death-roll of this insect army is greater than that of the Civil War.

First and for centuries the mosquito was merely a nuisance. Fat-witted man, sitting on the front-stoop of cliff- and cave-dwelling, wattled hut and marble palace, of a summer evening, has cried "Ouch!" smote himself sorely and jibbered that immemorial bromidium: "Well, he won't bite anybody else, anyhow."

Then the thin detectives of science, spying through thick glasses, risking and losing their own lives in the dangerous work, verified, at last, long harbored suspicions and brought home to the mosquito the certain proof of his crimes. Through the winged snakes of Herodotus, and in no other way, whatsoever, are malaria, yellow fever and a number of other diseases communicated to man. The pest becomes a pestilence; the nuisance a flying scourge of the world.

Now come the historian and the sociologist, to join forces with the scientist and pile up the indictment against *anopheles*. It was the mosquito which made New York the most congested city in the world by making so much of Jersey, Long and Staten islands impossible as places of suburban residence; which filled and fills the tropics with weak and spiritless people by injecting the parasitic worm, *filariasis*, into their anaemic veins. It was not the Goths and

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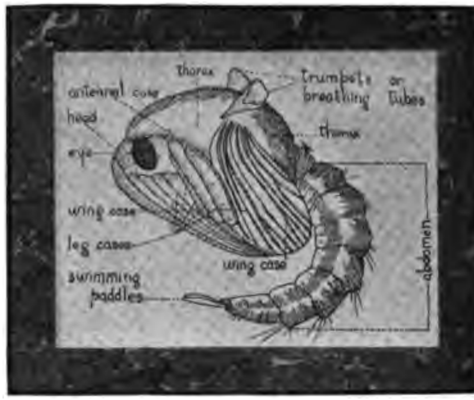
Vandals; not its own luxury and vice and corruption which brought great Rome to the dust. It was the mosquito which thinned the hot, proud blood of Julius Cæsar with the germs of malària; shook and broke the stubborn wills of the old Romans with chills and fever and made them easy victims to uninoculated arms from the North.

On the sea shore, not far from New York, there stood a cluster of handsome suburban villas. The ground which they occupied was high. It sloped stiffly up from the ocean. The hottest summer days were tempered by the vitalizing breeze which blew in from the wide Atlantic. Once in a time there were a few mosquitoes about, but malaria was a thing unknown. Never had these favored villa-dwellers been attacked by any of the slow fevers which sometimes afflict those who hug the sea. The town boasted, with full justice, its salubrity. The price of its five acre lots rose and doubled. Roses bloomed on the cheeks of its women and children. Its men went keen and alert about their work, their hearts pumping clean, red blood, their lungs freshened nightly by the clear, cool breath of the ocean. There was only a single drawback to life in



A Mosquito Pupa with Parts Named.

Arcadia. Transportation to and from the city was slow and the trains infrequent. Finally the local railroad was persuaded to make improvements. As a first step it set about laying an extra track for express service. A great gang of sturdy Italian laborers was brought out to make ready the roadbed. They came in mid-June and camped for a couple of weeks in box-cars and tents at the bottom of the rise of ground which lifted the town a hundred feet into the air. By August the track was done and the fast trains running. A week

Feeler of Female Mosquito, Greatly Enlarged.

Wing of a Mosquito—From a Glass Model, Greatly Enlarged.

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later a woman living in one of the high villas was taken with a sudden chill, followed by a high fever. Before the end of the month there were a score of cases on the hilltops. The local doctor said it couldn't be malaria, because such a thing had never been heard of in that vicinity. Most of the villa-dwellers were well-to-do. They fled away to the mountains to escape the infection. In the fall not all of them came back. Next spring chills and fever were more common. Presently many of the villas were empty. The price of real estate dropped. Five acre lots were cut up into chicken farms and truck gardens.

HEAD OF MALE MOSQUITO.
Greatly magnified.

It was, of course, the degenerate descendants of Julius Cæsar who thus avenged their ancient fall on the masters of the new world. Fresh from the fever-stricken marshes of the Roman campagna, with their veins full of the germs of malaria, they had infected the immaculate mosquitoes of Arcadia, which had, in turn, poisoned the blue blood of the villa-dwellers and thus helped history to repeat itself.

A man driving through southern New Jersey noticed the well watered fields, the rich, lush pastures and decided that here was an ideal dairy country. He built his barns and, with the coming of May, turned his herd of sleek, thin-skinned Jerseys out to graze. But with May also came the mosquitoes. The tortured cows grew thin and scrawny. They were kept restless and nervous. They gave little milk and that was thin and poor in quality. A single season proved that a profitable dairy farm in that

A LARGE MODEL OF MOSQUITO LARVA OR "WIGGLER."

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region was impossible. Other men followed. The experiment was tried again and again. It always failed. But for the mosquito pure, rich milk would be easier to get in Philadelphia and the price might well be less than it is at present. Because of the mosquito the state of New Jersey is deprived of the profit which would follow the establishment of a great and thriving industry.

HEAD, FEELERS, AND LANCE OF FEMALE MOSQUITO.
Greatly magnified.

Many parts of the same state, especially along the sea shore, are excellently adapted to the growing of small fruits. The bushes and plants make excellent growth and bear large crops of fine fruit. But who shall do the picking? Time and again gangs of Italian laborers have been brought out from the city at high wages to gather the berries. Once face to face with the ancient and victorious enemy of their race they have endured the torture for a few hours, then fled in utter rout, leaving the fruit to rot. But for the mosquito small fruits would be cheaper and more plentiful in New York and Philadelphia, and Jersey would add great sums to its annual income.

Every climate is the mosquito's choice. In the remote tropics the explorer who disturbs for the first time with the prow of his adventuring canoe the surface of a winding river finds a cloud of microscopic spearsmen waiting his arrival. In the great North Woods the mosquitoes drive the deer into deep water and the growl of their baffled buzzing about the bar of the sleeping woodsman is almost terrifying. The prospector, toiling under his pack in ice-bound Alaska, knows no respite from their stings.

By comparison, the red Indian with his tomahawk and the black Somali savage with his war-club are welcome dinner guests; the rattle-snake and the catamount are pleasant family pets.

Science has demonstrated that the only way a man can acquire malaria is to be bitten by a mosquito which is infected with the germ of the disease and, conversely, that the only way a mosquito can become infected is to bite a man which already has the disease. Just as it is impossible for the wisest highbrow to determine whether the hen or the egg came first in the ancestry of domestic poultry, so science gives up the problem of finding the beginning of the vicious circle of malaria. How the first man to acquire the disease could have acquired it by being bitten by a mosquito which could not have been infected except by biting a man who already had it must forever remain an unsettled, if quite academic question. Remains the fact that the only practical way to break the circle is to exterminate *anopheles,* which, when the constitutional aversion

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One of the Whiskers of a Male Mosquito.
It is supposed to be an organ of hearing.

of the species to race-suicide is considered, is really a man's sized job.

If quite protected against infant mortality and untoward accidents a single pair of mosquitoes not only can, but inevitably will become the ancestors of ten billion descendants during the waxing and waning of two summer moons. Mother mosquito lays four hundred eggs at a time. They float in clusters like tiny rafts along the edges of stagnant ponds. In a couple of days the eggs hatch and out of each swims a small wiggler. It takes about five days for the wiggler to feel the need of a change. Then he sheds his skull and his face and a few other portions of his anatomy, folds what is left up into a tight little bundle and waits three days longer before floating up to the top of the water and taking to the air as a full fledged adult of his or her race. And then, within forty-eight hours, each of the new-hatched females will do her duty in the egg-laying line. Once the first brood of four hundred is at work it would take the experts of the steel trust to figure out the increase for thirty days.

Fortunately for man, in his effort to extirpate the race, a great many of the egg-boats are destroyed before hatching. Then the small wigglers have the pleasing habit of biting off pieces of their sisters and brothers and many a pupa, aspiring to flight, has been caught by a ripple on the surface of the water and drowned before it could shake out its filmy wings, which is why mosquitoes are found near small and stagnant ponds or puddles and never in the vicinity of running streams or bodies of water exposed to the violence of the wind. Wigglers by the million are also eaten by small fish and by dragon flies, though the latter are too fond of basking idly in the sun to live up to their possibilities in

Eggs of Malaria Mosquito. Greatly Magnified.

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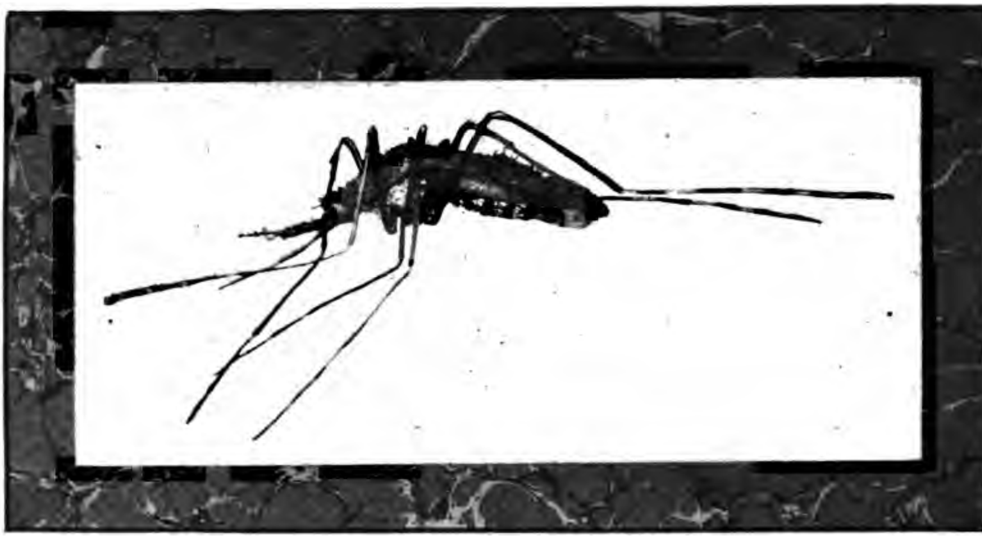

A GREATLY ENLARGED MODEL OF THE SWAMP MOSQUITO.

the devouring line and to be real aids in the business of extermination.

In addition to her egg-laying proclivities the mother mosquito boasts an astounding vitality. She will calmly repose on a cake of ice all winter and, then, with the first warm sun of May, will get up, stretch her wings and painstakingly go about the business for which she was created.

But in spite of its cold- and heat-resisting qualities and of its vast fecundity, man has found a comparatively easy and simple method of bringing the race of mosquitoes to a timely end. To drain all swamps and fill up all depressions where water might collect and stand would, of course, make the work of extermination complete and permanent. Pending the completion of such a large and costly undertaking, it suffices to screen all open vessels containing water and to pour upon the surface of standing pools and puddles a thin layer of crude petroleum. Repeated every ten days this treatment will, within a couple of months, smother the last remaining wiggler and banish the last fear of malaria. If no untreated puddles are left within 200 yards of a house, few or no mosquitos will appear, for they rarely fly further than that from the spot where they are hatched.

While this grim work of wiping out one of our oldest and most numerous families is under way in various parts of the country, it is only fair to point out that of the more than hundred species of mosquitoes only two have any regular disease bearing proclivities—*anopheles,* which carries the malaria germ

SILHOUETTE PHOTOGRAPHS OF MOSQUITOES TAKEN WHILE BITING.
The one at left is in characteristic attitude of the yellow fever species; the one at right of the malaria species.

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Poison Glands of the Mosquito.

in its saliva, and *stegomyia,* the awesome herald of yellow fever. Any one of the remaining ninety-nine varieties may, of course, produce blood poisoning by a single bite, if its beak happens to be infected, and to all of them must be charged many cases of nervousness and insomnia, while there are instances of men driven into violent insanity by the persecutions of the pests. At least three of the larger varieties—very giants in size—are cannibals and devote their best energies to devouring their smaller and more dangerous kinsmen, thus doing something, perhaps, to raise the average morality of their race.

Counting them all and considering the savage and remote regions where so many billions live and die it is safe to say that not one in twenty ever tastes blood of any kind, living instead on the thinner juices of leaves and tender shoots. The swimming wigglers do, indeed, a little scavenger work, in the way of eating decaying vegetation in the ponds and puddles where they make their temporary homes. But, that aside, not the most fervent mosquitarian has ever been able to discover that the whole swarming race has any useful or beneficent purpose in the world. The best they do is to annoy; the worst to slay on a Napoleonic scale. *Anopheles* kills twenty

Extracting "Wigglers."
A glass pipette is used to take them from the breeding jar.

thousand people each year in the United States.

The malaria bearing mosquito pursues its villainous business only under cover of night. Usually it is marked with black spots on its wings and it differs from *culex,* the comparatively harmless and more common species, in that its back is straight, while that of *culex* is distinctly humped. The male *anopheles,*

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which is perfectly harmless, wears a bunch of bushy antennae on his head; the female—as usual the only dangerous member of the family—affects plain and simple millinery. Her feelers are straight and plain. The common mosquito has only one prong to her bill; *anopheles* triples the agony with her three-pronged lancet.

So with absolutely nothing in its favor and most of the crimes and calamities of history laid at its door, the ultimate doom of the mosquito has been pronounced. Presently, when the farmer covers the rain barrel with netting and the suburban dweller goes over the place regularly, with the trusty kerosene can in his hand, the shrill war cry of the scourge will be heard no longer. Then, for the first time, will the downfall of ancient Rome be avenged upon the progeny of the real enemy of the Romans.

WHO GETS TO THE TOP?

By SAMUEL O. DUNN

Western Editorial Manager, Railroad Age Gazette.

WHEN the civil war began a young man named Marvin Hughitt was a train despatcher on the St. Louis, Alton & Chicago, now the Chicago & Alton Railway. He had entered the service of the road a few years before as a telegraph operator. He lacked the advantage of a college education and training. But he soon showed that he had qualities such as no college can give, however helpful it may be in developing them.

It became necessary to move large bodies of Union soldiers southward over the St. Louis, Alton & Chicago. On the train despatcher fell the chief burden and responsibility of seeing that the scores of extra trains bearing these thousands of men were handled rapidly and without accident. There were no double track railways in the west then; the code of train rules had not been developed to anything like its present perfection; there were no block signals and interlocking devices. Safety of railway operation depended much more than at present on the despatcher's vigilance, skill, judgment and resourcefulness. Young Hughitt proved so well, in getting over the road the trains bearing the Union troops, that he had these qualities in rare degree, that in 1862 he was made a superintendent on the Illinois Central. His rise on different roads was steady and rapid from that time; and now for twenty-two years he has been president of the Chicago & Northwestern, which he has done more than any other man to build up to its present greatness.

While Mr. Hughitt was getting trainloads of troops over the St. Louis, Alton & Chicago a young man named Alexander J. Cassatt was dragging a surveyor's chain as a rodman for the Pennsylvania Railroad. He had entered railway service with a very different educational equipment from Mr. Hughitt. He had graduated as a civil engineer after a full course at Rensselaer Polytechnic Institute, and had also studied in France and taken a university course at Darmstadt. When but twenty-eight years old he held the responsible position of superintendent of motive power of the Pennsylvania; when but thirty-two he was general manager; when thirty-five vice president.

Before this he had not only shown great ability in every position he had held, but he had been the means, while general manager, of causing the execution of one of the boldest financial coups in railway history. One day Robert Garrett, then vice president of the Baltimore & Ohio, walked into the office of

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George B. Roberts, president of the Pennsylvania, and said, with evident satisfaction: "Mr. Roberts, we have secured control of the Philadelphia, Wilmington & Baltimore, but we will not disturb your relations with it." Now, this road was considered a part of the Pennsylvania System and Mr. Roberts' chagrin was apparent. But after the visitor had gone Mr. Cassatt remarked that he knew where a controlling block of the stock could be secured at once. At a meeting of the Pennsylvania's directors that very night a check was drawn for $15,000,000; and the Baltimore & Ohio forces awakened the next morning to find that they had been completely routed.

This being an example of the knowledge and resources always shown by Mr. Cassatt regarding everything pertaining to the business of his road, it is not surprising that when he died two years ago, after having been eight years president of the Pennsylvania System, he had been long recognized as one of the greatest railway men that ever lived.

Mr. Hughitt and Mr. Cassatt were for years the best representatives of two schools of railway executives. Mr. Hughitt represents the very large school that is composed of men who entered the service without any previous technical training. Most of its members started as telegraph operators. Among the former telegraph operators who are now presidents of railways are such men as W. C. Brown, who was elected recently president of all the New York Central lines; A. J. Earling, of the Chicago, Milwaukee & St. Paul; Milton H. Smith, of the Louisville & Nashville; T. M. Emerson, of the Atlantic Coast Line; W. A. Gardner, who is both vice president of the Chicago & Northwestern and president of the Chicago, St. Paul, Minneapolis & Omaha; and William Cotter, of the Pere Marquette. To the same school belongs Sir William C. Van Horne, for years president, and now chairman of the board of the Canadian Pacific, and the greatest railway man in Canada. He entered railway service in the United States fifty-two years ago as a telegraph operator on the Illinois Central. Probably a majority of the vice presidents in charge of operation of big American railways are ex-telegraph operators. A very large majority of them have risen from the ranks of the service without having had the advantage of technical training.

A. J. CASSATT. MARVIN HUGHITT.

Mr. Cassatt and Mr. Hughitt were for years the best representatives of two classes of railway operating executives—the former of those who started with a technical education, the latter of those who began at the bottom of the ladder without any such training.

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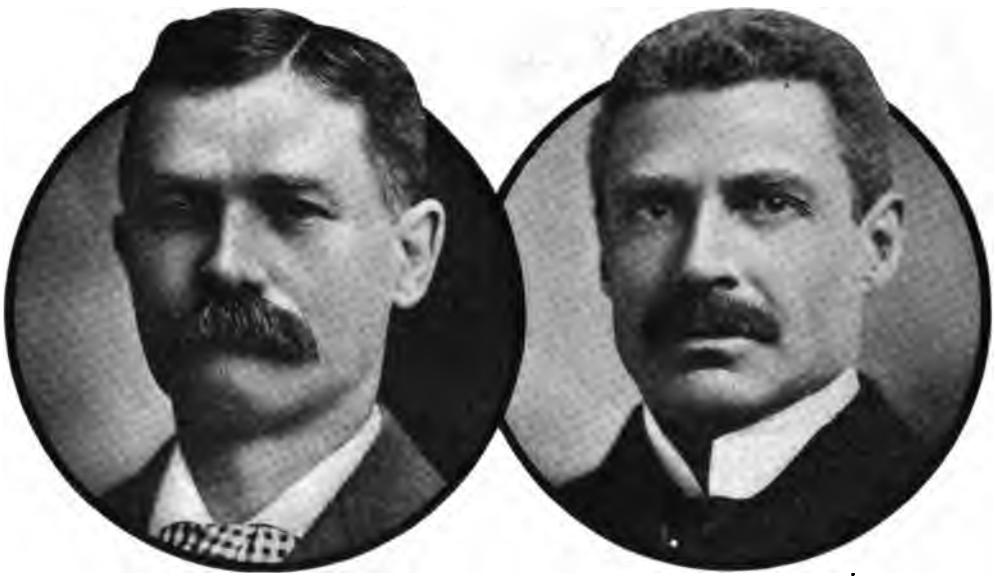
While the Van Horne-Hughitt school has been—and still is—predominant in the management of American railways, the number of members of the Cassatt school—of men who have had thorough education in the great technical schools—who are rising to the highest positions is steadily increasing and promises to increase much faster in the future. Mr. Cassatt's successor as president of the Pennsylvania, James McCrea, is an engineer. So, among others, are Howard Elliott, president of the Northern Pacific; S. M. Felton, president of the Mexican Central, and formerly president of the Chicago & Alton; E. N. Brown, president of the National Lines of Mexico; Julius Kruttschnitt, director of maintenance and operation of the Harriman lines; J. W. Kendrick, vice president of the Santa Fe; George L. Potter, vice president of the Baltimore & Ohio; and three vice presidents of the Pennsylvania, Joseph Wood, Samuel Rea and W. W. Atterbury.



WILLIAM A. GARDNER. SAMUEL REA.

Mr. Gardner is a type of the younger generation of railway executives who have risen from the telegraph operator's key, while Mr. Rea is a type of those who started in railway work with an engineering education.

The belief that the number of technically-educated men rising to high positions as operating executives of railways will rapidly increase, while the number of telegraph operators rising to such places will diminish, is based on a number of important changes that have taken place in recent years. In the days when such men as Marvin Hughitt and A. J. Earling were train despatchers—even in the still later period when such men as W. A. Gardner, I. G. Rawn, vice president of the Illinois Central, and E. E. Calvin, vice president of the Southern Pacific, were despatchers—train despatching, with its long hours, its heavy responsibility, its incessant, nerve-racking strain, and the clear head, the quick, correct decisions and inexhaustible resourcefulness that it required, was as good an experience as could be devised by human ingenuity to test whether a man had natural executive ability, and, if he had it, to teach him to use it successfully in the all-important work of handling men and getting out of them the best there was in them.

The introduction of the block signal system has lightened the strain and responsibility on despatchers on lines of heavy traffic. The efforts of the labor unions, and national and state legislation, have reduced the number of hours that they may work. The telephone is

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rapidly supplanting the telegraph for despatching. Now, no doubt, most of these changes, and others that might be mentioned, are in the interest of better and safer transportation. But they have made the despatcher's office a less efficient school for developing numerous young men with the fine executive ability needed for superintendents, general managers, operating vice presidents and presidents.

Technically-trained men stand a good deal the best chance of being used to fill the resulting gap. For some years the Pennsylvania System has made a rule of filling all important executive positions in its operating department with trained engineers. As already stated, President McCrea and three vice presidents of this system are engineers; and so are most of their official subordinates in the operating department.

Just recently the Harriman lines have been introducing a plan of organization that will give technical men a much better chance to rise on these roads.

The organization of a railway is divided into several departments, of which the operating and traffic are the most important. The traffic department sells the transportation which the operating department provides. The operating department has three subdivisions, the civil engineering, which builds the roadway and keeps it in good condition; the mechanical engineering, which keeps the locomotives and cars in good shape; and the transportation, whose business it is to get trains over the road. A vast majority of railway presidents have risen in the past from the transportation subdivision of the operating department. From despatcher, or conductor, or yardmaster, they have risen to trainmaster, then to superintendent, general superintendent, general manager, vice president, president. The division engineer or master mechanic—who usually are technically-educated men—could not, as a rule, hope to rise higher than to chief engineer or superintendent of motive power, these officers being in general charge, respectively, of maintenance of track and maintenance of equipment, and being subordinate to the general manager. But the management of the Pennsylvania concluded that if a man not only knew how to get trains over the road, but also had an engineering education, he would be a better railway man than one who merely knew how to get trains over the road. So it adopted

JAMES McCREA. A. J. EARLING.
Mr. McCrea and Mr. Earling are famous, among other things, for being the two most silent railway presidents in the United States. The former began his career as an engineer, the latter as a telegraph operator.

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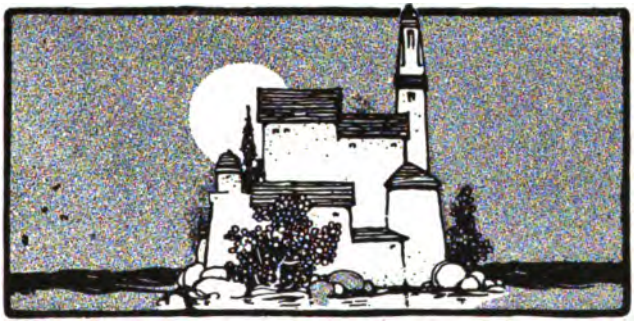
the policy of first trying technical men in places where they could use directly their technical knowledge; then shifting them to places where they could learn how trains were handled on the road; and then, finally, making them transportation officers, thus putting them in line for promotion to the highest offices. Similarly the Harriman lines are experimenting with a policy of giving the division engineer and the division master mechanic the title and authority of "assistant superintendent." In this position they have a chance to learn how the transportation department handles trains, while also performing their special technical work, and are in line for promotion to superintendent, general superintendent, general manager, etc.

The vice president in charge of operation of a large railway—himself a former telegraph operator—expressed the view of most railway officers the other day when he said that the future of technically-educated men on the railways is mainly in their own hands. He added that the trouble with such men in the past had been that, while they have entered railway service with knowledge which the roads need more and more all the time, they usually have shown less ability in handling men than have candidates for the higher offices who have risen from the ranks; and capacity for handling men is far and away the most important qualification of a successful railway operating officer. It is a qualification, however, as has been demonstrated on the Pennsylvania, that can be developed in technical men of good natural ability by putting them where they can get the right kind of experience.

There are great and growing opportunities on the railways for technical men; and the railways are destined to profit greatly through more extensive use of the expert knowledge and the ideas that they bring from the college class room, laboratory and workshop. The technical man is getting to the top.



It Never Forgets

No, the heart that has truly loved never forgets,
But as truly loves on to the close;
As the sunflower turns on her god when he sets
The same look which he turned when he rose.

—MOORE.

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OPERATOR RECEIVING AN AEROGRAM.

STRUGGLING FOR THE AIR*

By FRANK DOIG

WHO owns the air?

Or, rather who owns the great unknown way of the universe, on which puny man has launched his latest system of communication?

These seem to be absurd questions, but already international complications threaten to arise over them. The strange situation all comes about through the latest developments of wireless telegraphy.

As might be expected, it has remained for the far corner of the Northwest, the Pacific frontier, to be the battle ground for control of the ether way. Already there are sullen rumblings of the coming conflict. The Canadian government wireless telegraph operators are wondering when a more satisfactory agreement will be made with the Americans than now exists for sending aerograms.

It is a curious fact that when two wireless stations are working, another station in the vicinity can break into the ether way and stop the working stations. In the operators' terms this is known as "interference." To some extent science has overcome this difficulty by the use of a device known as a tuner. With this instrument the operator can "tune

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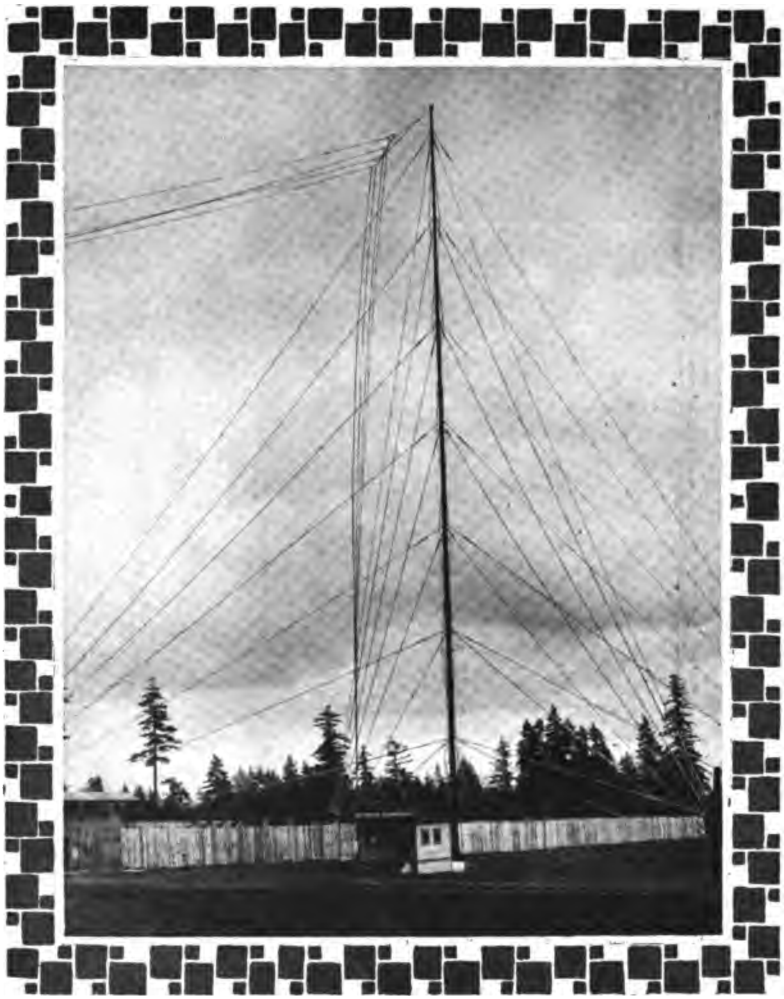
out," that is, shut off stations which he does not want to hear. This operation, however, restricts the use of the atmosphere again, so that in the end the struggle for air is little further advanced than if the tuner was not in use.

The tuner has this advantage: it allows an operator to work in peace, even though others do want to interfere and get their messages through. And again looking at it from this viewpoint, it is might that rules. And the struggle for air goes on just the same.

In the air over Puget Sound and around the Island of Vancouver, four separate interests may clash by wireless. This condition undoubtedly is unparalleled anywhere else above this earth. In the first place there are the Canadian government stations, with six or seven active instruments. The American government has stations at Bremerton and Tatoosh which are in the struggle for right of way. The vessels of the Pacific Coast Steamship Company, four in number, are equipped with a system of wireless. This system, although of little importance in the fight for air, sometimes might play an unyielding part. And then comes a great commercial company



SEATTLE STATION OF UNITED WIRELESS.
Situated on the University of Washington campus, the mast, 210 feet high, supports 1,000 feet of wire antennae.

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Wireless Station, Yerba Buena Island, California.

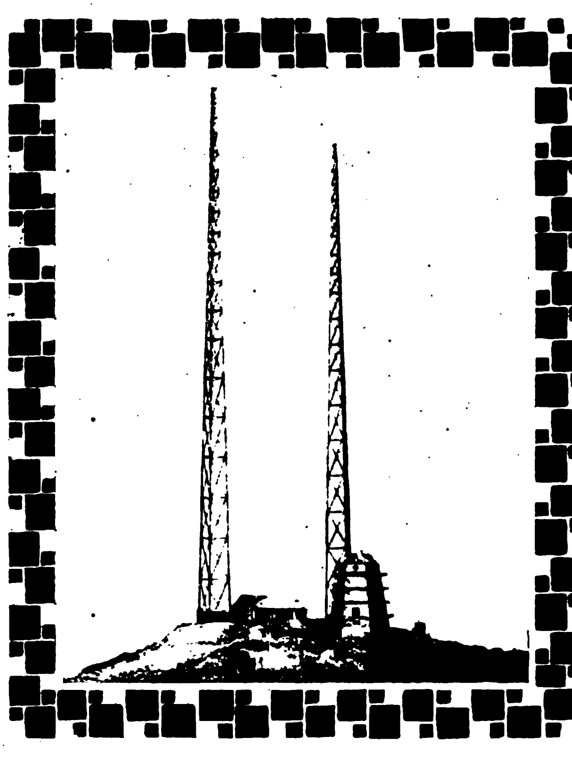
schedules on which they work. It is agreed for instance, that the Dominion stations work a certain part of the hour and other operators will remain quiet. Then the commercial men have their turn, or the American government stations work. As a matter of fact, however, in actual practice, the government stations on this side of the line take little of the time, so the field is practically left clear for the commercial men.

But this agreement is only a verbal, or rather a wireless contract, and is not binding. At any time the agreement may be overstepped. Then it will be a struggle for control, with the most powerful stations winning.

Perhaps it was this contingency that was foreseen by the with its powerful land stations and its great fleet of Pacific Coast, Puget Sound and Oriental liners all demanding their share of the ether way, without interference, and getting it.

Another element that sometimes must be considered is the fleet of Japanese boats plying between the Orient and Puget Sound. These are now equipped with wireless apparatus. The Japanese government owns all these instruments and the operators are members of the Japanese navy. If these operators choose to work their instruments, who is there to say they shall not?

Although the possibilities for the future control of the air are uncertain, at the present time the operators of the land stations in the Puget Sound and Pacific Coast districts have



Towers of the Wireless Station on Mount Tamalpais, California.

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American navy department and which brought about the decision to have American warships equipped with the most powerful instruments obtainable for practical use aboard ship. Bids have been asked for instruments capable of receiving messages from a distance of 3,000 miles and sending them 1,000 miles. It is planned to establish a number of land stations able to dispatch wireless messages 3,000 miles. One high power station is to be erected at some point near Washington, D. C. It is specifically stated in the call for bids that this station must be able to transmit a message 3,000 miles, free from atmospheric, international or uninternational interference in any navigable direction, night or day.

It is this plain clause that has caused the wireless experts to do some deep thinking. They are wondering if the government is planning to control the ether way by might.

In Canada, it is believed the government is already at work on the problem of solving the right to the Hertzian waves. There is nothing to prevent the northern neighbor building powerful wireless stations that might interfere with the United States navy communication. Or the commercial companies, which have some of the best expert wireless inventors and engineers in the world on their staffs, are at liberty to tamper with the wavelets at will.

Supposing Congress should see fit to attempt the passage of a bill regulating the use of the atmosphere, it cannot hope to control the entire ether envelope. A station, powerful enough, situated on a desert isle would be able to fight for its share of the waves, without interference.

A FIGHTER FOR THE AIR.
H. E. McIsaac, who holds some of the long distance transmission records of the world.

True, wireless is still in its infancy and many improved tuners may be invented to overcome interference. In fact two Italians, Pellini and Tosi, announced recently that they have solved the problem of absolutely independent wireless operation. For the last eighteen months they have been working with the sanction of the French government, with the wireless stations on the coast of Normandy. They declare this result has been obtained by means of two rectangular aerials fixed at right angles and so attached to the apparatus for reception and transmission as to permit the transmission of unequal currents. By a simple law of mechanics these two electric magnetic forces unite and produce an electric magnetic field and the Hertzian waves are projected in a single vertical plane, which can be altered instantly by means of the Bobine device.

The inventors say they have picked up messages at will from every English station and from ships at sea and that they have transmitted messages between various points without the waves being perceptible at the other stations, lying just off the line of transmission.

If these claims are true, the device will go a long way toward settling this problem. But even this attachment will not prevent other stations interfering with those that are working.

Similar results have been obtained with the tuner used by the commercial engineers in this country. For instance, the Victoria station can "tune out" all

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Canadian stations and work with Seattle, without interference.

But another element has been thrust into the strife. It was only last fall when the operator at the commercial station on Russian Hill, San Francisco, began hearing mysterious messages coming over the great unknown way from far off in the ether envelope. Away out there in the night someone was calling. He strained his ears to catch the faint dots and dashes. Finally they stopped. He had been unable to grasp their meaning.

The following night, long after the usual night business had been transacted, Operator Lawrence Malarin, with his head receivers tightly clasped to his ears, sat beside his operating table in the little house overlooking the Pacific. It was an ideal "wireless night." His silicon for receiving was in fine order. Not a speck of dust on his delicate instruments anywhere.

Suddenly, the faint mysterious signals came to his ear. In a few seconds they grew more distinct. Now he was able to distinguish the letters of the alphabet. Then his hopes were shattered, for the clicks ran off into a sputter of dots and dashes he didn't understand. Again came the letters and he wrote them down as they came. The sender seemed to be using a mixture of Continental and Morse codes. Malarin, familiar with both could make no sense out of the combination he heard. Nevertheless he took down in writing what came.

INTERIOR OF HIGH POWER UNITED WIRELESS STATION AT SEATTLE.

The next day he consulted with James O. Watkins, his fellow operator. It was then the truth flashed upon them. They hunted up a code book, giving the systems in use by the Oriental countries.

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Malarin had heard a wireless message direct from Japan. Over 5,761 miles of ocean the vibrations carried. This established the long distance record of the world.

This feat opens another avenue for a possible struggle for air. It may be the powers of the world will be called upon to establish the right of way over the air above the Pacific. At present Japan is not a dangerous competitor for the ether way. Japan has solved the secret of powerful sending instruments, but the little brown inventors have not yet learned the trick of perfecting a receiving apparatus. But already the Japanese government has agents in this country attempting to master the secret of the patented receiving devices and if these little people are worthy of their name, "the Yankees of the Far East," they unquestionably will sooner or later discover the secret.

A CANADIAN GOVERNMENT STATION AT CAPE LAZO, VANCOUVER ISLAND.

Every Man Alone

We are spirits clad in veils;
Man by man was never seen;
All our deep communing fails
To remove the shadowy screen.

—C. P. CRANCH.

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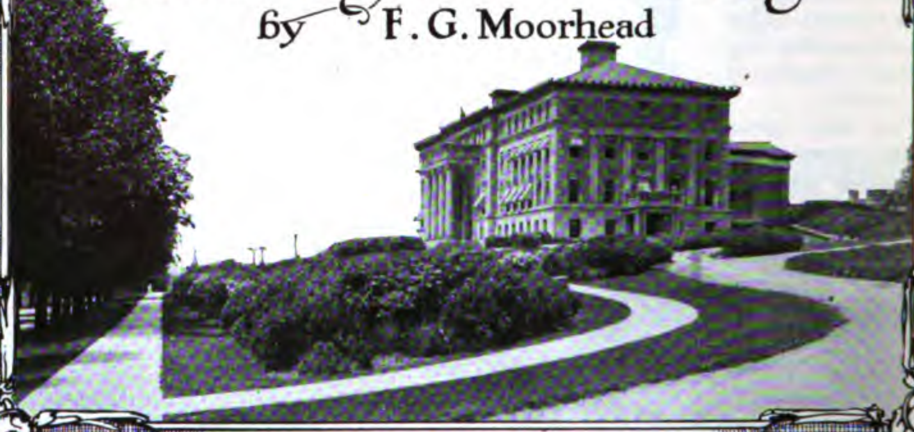
Catching Them Young

By F. G. Moorhead



This article describes for the first time one of the most important and most significant developments in the public school system of the United States. It seems in a fair way to furnish an answer to the old question: How shall the boys and girls be kept on the farm? Naturally, the scene of this most interesting advance is the great Middle West, where Democracy seems most alert to its dangers and most ingenious and determined in solving its problems.

THE American corn belt devotes sixty-five million acres to the crop and raises one and three-quarter billion bushels, adding a billion dollars to the wealth of the nation every year. It comprises the twelve states of Illinois, Iowa, Missouri, Kansas, Nebraska, Oklahoma, South Dakota, Michigan, Minnesota, Wisconsin, Ohio, and Indiana, and in addition to producing three-fourths of America's chiefest crop leads the world in the output of dairy products and the yield of oats, barley, timothy and potatoes. But the greatest crop, which it has at last devoted itself to raising, is that of farm boys and farm girls.

Great and wealthy as the corn belt is, it has at last wakened to the fact that it cannot much longer lead the world in raising corn and oats and barley "and other things" if it does not at least try to lead in rearing boys and girls who will stay on the farm. By means of the new science of agronomy it has within recent years learned how to increase its cereal and dairy yield. Unlike Mark Twain, who claims to be the only farmer in Connecticut who can "make two blades of grass grow where three grew before," there are a hundred thousand farmers in the corn belt who have learned literally how to raise two blades of grass and two ears of corn where but one grew before. But of what value is this knowledge if sons and daughters are to quit the farm, leaving corn-belt prosperity to the haphazard agriculture of the city-born and of transplanted foreigners who find conditions and climate vastly different from those of the Fatherland? Therefore the corn belt has at last set itself to raising that greater and more valuable crop of farm boys and farm girls who find material comforts and ample financial recompense on the farm.

The greatest factor in the raising of this new crop is education. To one of the corn-belt states belongs the honor of having the oldest agricultural college

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now in operation in North America. The statute creating the Michigan institution was passed in 1855 and the college opened two years later. Five years after Michigan led the way Congress passed the Land Grant act giving to each state a certain amount of land, the proceeds from the sale of which were to be used in colleges of agriculture and mechanic arts. As a result there are today forty-nine institutions endowed by Congress to teach farming to the ambitious young men and women of the country.

But the farm boys and girls, in order to be interested, must be "caught young." Before they are old enough to enter the Land Grant colleges the lure of the city has entered their minds and the mischief is done. Raising bumper crops of corn and oats the typically agricultural states of America have heretofore failed to raise satisfactory crops of stay-at-home boys and girls.

Not until forty years after the experiment of the colleges which it was fondly hoped would solve the problem was the necessity fully realized of sowing the seed earlier and reaping the crop younger. Today, fifty-six years after New York tried the experiment of schools of agriculture and failed, the corn belt is trying the experiment of schools of agriculture preparatory to the regular Land Grant colleges, and is succeeding. Today, each of the twelve states in the corn belt is teaching farming, either in the regular schools of both city and country or in special agricultural high schools. "We know now that we want agriculture taught in our rural schools," asserts one convert. The old-time theory that farm boys and farm girls could learn enough about the farm while working on it, that they must learn of city things if knowledge was to go beyond "readin', 'ritin' and 'rithmetic" has been discarded and from one end of the corn belt to another so-called secondary agricultural schools are springing up and farming is being taught even in the lowest grades of the regular

ANIMAL HUSBANDRY CLASS AT ONE OF THE SECONDARY AGRICULTURAL HIGH SCHOOLS.

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public schools, in a far-reaching crusade to keep the farm-born on the farm.

Wisconsin has made the greatest headway in the matter. The Agricultural college at Madison gives four-year and two-year courses and a short course requiring two winters of three months each to complete. In addition there is an Institute lasting two weeks, usually in February, which only adult farmers and their wives are allowed to attend and which they do attend literally by the thousands. In 1901 the legislature enacted a law providing for the establishment of secondary schools of agriculture and domestic science, of which there are now five, situated at Menomminie, Wausau, Winneconne, Marinette, and Onalaska, with another in process of establishment at Green Bay and two more soon to be located. These schools are supported in part by the counties in which they are situated and in part by the state. Instruction is given in soil study, plant and animal life, shop practice in wood and iron work, farm building architecture, landscape gardening, farm dairying, animal husbandry, poultry raising, fruit growing and study of insect life. The average attendance at each of the schools is about sixty boys and girls, with the summer course attracting fully three times the number. In addition, instruction in elementary agriculture is given in all rural schools and some high schools. Speaking of the situation State Superintendent C. R. Cary says: "It seems likely that the number of county schools of agriculture will increase until a majority of all the counties will have them within their borders. There is great interest taken in the subject of agricultural education in this state."

Some of the high schools of Minnesota are teaching farming with much success, notably at Albert Lea, Canby and Hinckley, while Glencoe and Litchfield are making ambitious plans for next year and the last session of the legislature passed a bill providing for an agricultural course in ten high schools and a state appropriation of $2,500. At Canby and Albert Lea the school boards obtained by lease or free grant the use of sufficient land to give practical farm experience to eighty-five young folks in the former place and 260 in the latter. Each child is given a plat of ground ten feet by four and allowed the product, one eighth-grade boy at Albert Lea netting $2.70 from his tiny farm in one season. During the winter months the subject is pursued in text-books. The state has two Schools of Agriculture preparatory to the Agricultural college, one at St. Paul and the other at Crookston, offering a "practical course of study designed to fit young men and women for successful farm life and provide an intermediate year for those who wish to enter the college of agriculture." The former was established in 1888 and accommodates about 600 students, the school year running from October to March, with a three-year course provided. All male students are required to have had six months' farm practice before entering the school. The success of the work is shown by the fact that over eighty per cent of the graduates of these agricultural schools continue farming.

Agriculture is required to be taught in all the common schools of Oklahoma and is taught in all of the six state normals and in the University Preparatory. The state has two secondary agricultural schools already established and four more will be located shortly, it being the intention to have one in each supreme court district. The one at Tishomingo was opened October 5, 1908, while the one at Warner was opened February 1, 1909. The purpose of each is to "give the boys and girls of the farms, villages and towns an opportunity to secure a well-rounded education and to learn not only how things should be done, but how to do them and why." A three-year regular and a three-year preparatory course are offered, together with a short course of two weeks for adult farmers and their wives. In order to make these schools still more popular a movement is on foot to organize boys' and girls' clubs throughout the state to create an interest in the common schools. After this year no person may teach in the common schools unless his certificate shows him to be qualified to give instruction in agriculture. After January 1, 1910, the state appropriation will be available for the maintenance of what

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is known as the Russell demonstration farm in each of the seventy-five counties. This law, enacted by the last legislature, authorizes the state board of agriculture to contract with some capable and responsible farmer in each county for the cultivation of forty acres of land in a manner to be prescribed by the board, the latter furnishing the seed. The farmer is required to keep an accurate record of his work. He receives all profits from the sale of his products, and should his experiments prove a failure, he may be reimbursed by the state in a sum not greater than $250 a year. Oklahoma has appropriated for this purpose the sum of $20,000 each for the years 1910 and 1911.

INSTRUCTING THE YOUNG FARMER.
Prof. P. G. Holden teaching young farm boys how to judge and classify ears of corn.

A DOMESTIC ECONOMY CLASS FOR FARMERS' DAUGHTERS AND WIVES.
Attended by those unable to spend the time or money at the regular agricultural college.

Notwithstanding its "show me" reputation, Missouri has taken up the matter with enthusiasm, agriculture being taught already in many of the city and town high schools and the simpler phases in grades as low as the sixth. The recent legislature passed a bill making its teaching compulsory in all public schools. In addition to the State Agricultural college the subject is pursued in all five state normal schools, in Lincoln Institute for colored teachers and in several of the private colleges of the state. The State Normal School at Kirksville expects soon to have a farm run in connection, $15,000 to be spent in acquiring an eighty-five acre tract and in erecting the necessary buildings for the young farmers. Thorough training in dairying and poultry raising is contemplated, while the farm building and equipment will be as nearly perfect as possible. "The movement is growing rapidly," reports State Superintendent Howard A. Gass. "Nature study leading to elementary agriculture and the simpler phases of the subject itself are being taught in the elementary schools. Courses covering from one-half year to two years are being offered in more high schools every year. Steps are being

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A CLASS IN ANIMAL HUSBANDRY.
This is for those who are unable to attend the regular Land Grant Agricultural College.

taken to establish a distinct agricultural high school near Centralia. This school will be established by private enterprise, but will operate under the direction of the State Agricultural college, for which it will give preparatory training. Several bills were before the last session of the legislature to establish agricultural schools."

Twenty-three of the high schools of Kansas taught agriculture last year and the number will be greatly increased next year. A large number of the rural schools of the state are also teaching the subject. The state has no separate agricultural high schools, those especially interested in the matter believing farming should become a part of the high schools already established, rather than that new and special ones should be provided. The agricultural college is assisting materially by the publication of bulletins suitable for teaching farming in graded schools, issuing them free to the teachers. A bill was introduced in the recent session of the legislature requiring teachers after May, 1911, to pass an examination in agriculture or home economics in order to secure a first or second grade certificate. It passed the house with practically no opposition, but did not reach the senate in time for consideration. It is predicted it will become a law at the next session. The legislature authorized every county in the state to make appropriations for the purchase or lease of experimental farms of not more than forty acres and created a state fund for the purpose of hiring additional experts in agronomy to superintend the county farm experiments. As a companion effort the state rural school teachers, under the direction of the state superintendent of education, have decided to take up the matter of farm education in the rural graded schools. September first, when the schools reopen, a uniform course of primary education will be installed in all rural schools which can get competent teachers. The demand for instructors is already larger than the supply.

Farming is taught to a limited extent in a number of the public schools of Michigan. The high school at North Adams has an agricultural department.

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The subject is also taught in the forty-eight county normal training schools, the teachers in twenty-one taking special work in the agricultural college during the last summer vacation. To a limited extent it is taught in the state normal schools. There is one agricultural high school, supported by Menominee County and without state aid up to the present time. President J. L. Snyder of the State Agricultural College at East Lansing reports: "This college has a department known under the title of agricultural education. One of its chief functions is to assist in introducing agriculture into our public schools and especially into our high schools. We believe we can see encouraging signs and we hope that within the next few years we may have a large number of high schools create agricultural departments, placing them in charge of well trained men."

While teaching theoretical farming even in the lower grades of the public schools and boasting one of the best agricultural colleges and experiment stations in the country, Iowa has not yet won the fight for intermediate and secondary agricultural schools, although private-controlled institutions and state-controlled summer schools and short courses are going a long ways toward meeting the deficiency. The legislature which adjourned in the spring considered a number of bills looking toward improving agricultural teaching, notably those providing for chairs of agriculture, with state aid, in all the accredited colleges of the state, the establishment of four state agricultural high schools and the teaching of the subject in the rural schools. "We know now that we want agriculture taught in our rural schools and agricultural high schools reaching down in grade to the common schools; it is the ninety-nine per cent of rural and town children we wish to reach directly," declared a prominent agriculturist before a state short course. Undoubtedly the next legislature will give the state what it is demanding. State aid has been given to farmers' institutes and $10,000 appropriated to further dairy instruction by means of demonstration trains and bulletins.

South Dakota and Nebraska have schools of agriculture similar to those which have proved so successful in Minnesota. In addition the subject is pursued in rather limited manner in many of the graded and high schools and to a greater extent in the normal schools of the former state, while in Nebraska all the larger public schools teach the subject and many of the private colleges make it an important part of the curriculum. Possessing one of the most thorough and comprehensive agricultural colleges of any state of the corn belt, Illinois is by no means neglecting preparatory instruction. While it has no agricultural high schools, the subject is taught in many of the graded schools and the movement under way to increase this teaching is likely to show considerable strength by the time the next legislature convenes. A great many of the consolidated schools of Indiana teach farming, while the higher branches are followed not only in the school of agriculture at Winona Lake but also at Purdue University. "We have been urging the teaching of agriculture in all of the consolidated schools, township graded and high schools and in the best country schools for a number of years," reports State Superintendent F. A. Cotton. "We have made tremendous progress in the last six years." The agricultural department of the State University of Ohio keeps a member of the faculty busy inspecting and encouraging agricultural training in various schools. Farming is taught in many township graded and high schools, the university placing the latter on the accredited list.

The success of the work in the corn belt is stirring up other sections of the country. Typical of the cotton belt are Alabama and Georgia, where agricultural schools have been established in each congressional district, supported in Georgia by the tag tax on fertilizers sold in the state and by fees and in Alabama by inspection fees on fertilizers and illuminating oil. New York has joined in the movement and established state schools, subsidiary to the College of Agriculture, at St. Lawrence University, at Alfred University and at Morrisville, Madison County. Typical of the wheat

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belt and the Northwest is North Dakota, where many of the graded schools offer courses and the School of Forestry and the Agricultural College take care of the higher branches. "An effort, in fact every possible effort, is being put forth by county superintendents and the department of public instruction to encourage the teaching of elementary agriculture in our common schools; the high school board is urging courses in the high schools," reports State Superintendent Stockwell. At present only seven of the seventy-six schools of the state offer the agricultural course, but it is probable that Inspector Richard Heyward will win his point when he says: "A scientific knowledge of agriculture would better conditions on the farm and make it more agreeable and profitable for young men and women to remain on the farm. As many of the teachers of the rural districts secure their preparation in high schools, the latter should offer courses in agriculture that the teachers in the elementary rural schools may be properly prepared. The high schools of the smaller towns should offer this course for the interest there would be in it, also for a number of their pupils who are not to be teachers, but will in some way be connected with farming interests."

From the first seed sown in the corn belt a crop of boys and girls loyal to the farm is being raised already, while the gospel of the new animated agronomy is spreading over all the country. The next three or four years are expected to show results and the movement from the country to the city be checked, for acres of corn become acres of gold dollars far easier and quicker than one may grub fortune from the pavements of our city streets.

Summer Dreams

Meadows trim with daisies pied,
Shallow brooks and rivers wide;
Towers and battlements it sees
Bosom'd high in tufted trees,
Where perhaps some beauty lies,
The cynosure of neighboring eyes.

—MILTON.

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Just Junk!

By Charles Dillon

"R-e-c-k-s unt olt i-i-run!
R-e-c-k-s unt olt i-i-run!"

UP and down the dirty back alleys drives the junk man, singing his mournful, nasal cry, loading his rickety wagon with broken scraps and pieces of old iron—an object of pity or of ridicule to most of the uninformed public.

Let him be admired or envied rather, for, if not he, himself, at least his employer is probably making more money than nine out of ten professional men. Better than that his work is of the utmost importance in the world and, in the aggregate reaches proportions almost beyond the belief of the casual man in the street.

Few things are more depressing and unsightly than a pile of junk as high as a two-story building. One may see such in every city and, so far as the casual observer can determine, none of the stuff is ever moved. The piles increase, apparently, from month to month and grow rustier and rustier but the men in the business keep on buying.

How are they able to keep so much money tied up? Where do they get the large amount of capital which seems to be necessary?

They borrow from the banks, like any other business man, on the security of their stock in trade.

"No better security," the president of almost any bank will declare. "It can neither burn nor blow away. It can't be damaged by water or smoke. Where is there a collateral like that? It is absolutely safe. The foundries and the nut and bolt works and the stove factories can't get along without it. It pays the largest profits of any business to which we lend money and these profits fluctuate very little. Junk is always in demand. The men in that business are excellent customers."

Whenever one goes to a junk yard where old iron lies in stacks nicely assorted as to grades, one learns how much may be done with system and close attention to business; how large an enterprise may be builded from an insignificant beginning. If few Americans engage in the junk business it is not so much that they fear to lose dignity in the commercial world as that they have not the patience to master the details of an industry which calls for exceptionally fine figuring, the ability or instinct to snap up bargains where few persons would see one.

Men whose business equipment in the beginning of their commercial life consisted of a few gunny sacks, an old wagon and a spavined horse have grown rich in a few years gathering junk. Think of it! They are to be found in any American city if one looks for them.

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At the Top of the Pile.
A mountain of old iron that reaches to the third-story windows.

Mostly they are Jews, but there are other nationalities — not many Americans and hardly ever an Englishman. I know two young Hebrews who began to gather junk eight or nine years ago with an outfit that kept the agents of the Humane society awake nights. They had been fairly well educated, they were energetic and ambitious and thrifty but they had no trade and they didn't care to follow in the footsteps of their progenitors and drag along in the clothing business. They worked hard and gradually improved their facilities. In a year they had three or four of their countrymen helping them, "hired men" working by the day. Things, especially junk, began to come their way. Four years ago these young men had saved up $1,700—gathered in the alleys and back yards of a large city. Then they leased one-quarter of a block of vacant ground past which ran a railroad track connecting them with the main line.

Today these two Hebrews have a business worth between $100,000 and $150,000 a year. They have excellently equipped offices, book-keepers and a stenographer; several traveling salesmen and buyers; they wear the apparel of uptown business men, with the addition of diamonds suggesting ownership in coal mines or a corner in wheat, and they entertain their associates at luncheon in the big hotels where the waiter's tip amounts to more than they paid for a wagon load of junk in the old days. They deal in car-load lots now and have contracts with the most important concerns in the country.

A fairly clear idea of the profit in junk may be gained in this incident: A mercantile house that carried a large stock of stoves was destroyed by fire and the stoves, of course, were ruined—so far as that firm was concerned. Mostly they were sheet iron affairs with pretty, nickel trimmings. The flames spoiled the polish and the nickel and the water rusted them. A total loss, the merchants said, but the two young Hebrews I have mentioned came along and bought the whole lot, about two hundred, I believe, for fifty cents apiece, just as they were in the ruins.

One of their regular employees cleaned the stoves and another, hired for the occasion, re-nickeled them for fifty cents apiece. The dents were straightened out and polish applied. When the job was finished the junk dealers had as decent a lot of stoves as anyone might care to see—in the less expensive section on bargain day. Then they sold them to a mercantile house for four dollars apiece, a net profit on every stove of more than three dollars.

"Old Henry" from Virginia.
He earns $20 a week sorting junk.

All first class junk

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dealers do a lucrative business in wrecking buildings. In these high pressure days men think little of tearing down a five- or ten-story structure to make room for another twice as high, and this gives a new dignity to those who believe in saving the scraps. I know several Hebrews and one American physician who have grown rich—that is they each have a paltry quarter- or half-million—by contracting to demolish buildings for the iron and steel and bronze, with other money considerations of profitable importance. This junk is practically handed to them, not forgetting the bonus which they are pretty certain to earn for exceeding a specified time limit.

The business of sorting junk comes very close to being a science. I know an old negro who earns twenty dollars a week at this work. He is an expert and takes as much pride in it as a motorman who stops the car with the steps right over the mud puddle. The firm which employs him brought him from Pittsburg to the West. It is impossible to fool him. He knows all the grades of iron and steel and other metals at a glance. In ten years no complaint ever has arisen from shipments sorted by him. This is important because quotations are based on quality and in many instances railroad rates depend upon the proper classification of the junk.

The several grades sell for varying prices averaging from $12 to $15 a ton, some of them $17.50. Pipe taken from dismantled buildings sells readily for $25 and $30 a ton and is almost as good as new pipe. "I" beams are bought for ridiculously low figures and after being painted are almost as serviceable as beams just turned out of the mills. Nearly all the street railways sell their worn brake-shoes to junk dealers who ship them to the foundries where they are made over into new shoes and returned, very often to the junk dealers who sell them back to the company.

IN THE "BREAKING" SHED.
Separating tin, iron, and lead.

THE HEAVIER KIND.
Car wheels, piping, etc.

East St. Louis, Chicago and Pittsburg are the principal buyers of junk. There are train loads of it in transit every day. At the foundries it is thrown into the furnaces in bundles as it is received, cut to proper lengths for convenience in handling. And when one sees it again it is in the form of rails and plow shares and nuts and bolts and the hundreds of other things that are needed today in the building of cities.

When one considers junk in a national way one is more than ever surprised. The managers of five great iron and steel works estimate the mill consumption of this old material for 1907 at twelve to twelve and one-half million tons. If that isn't sufficiently impressive one has only to reckon the average price by the ton. Some kinds have gone down to $4 and others up to $28 and $35 but a fair medium, the big buyers say,

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is $12 to $12.50. The total selling price, at that figure, amounts to the stupendous sum of more than $144,000,000! Something doing in the junk line?

When some of the leading steel and iron men were asked about junk they were very much amazed that an item so important should have been overlooked all these years, especially as they had been paying for it. Never had given it a thought in a human way.

"Twelve million tons!" one exclaimed. "Well, who would have thought it? Why, that's nearly one-half the pig iron production in 1907. Funny, isn't it, what things we miss?"

In 1907 the United States produced 25,781,361 tons of pig iron. And in the same year the mills were using nearly one-half as much junk as new pig iron in making the things that are made of iron and steel.

MAKING THE KICK RELOAD THE GUN

By H. G. HUNTING

EVER since men began to kill each other, which was very soon after selfish interests began to clash, a good share of their leisure time has been devoted to the elevating pursuit of inventing instruments for that killing. From the time when the early prowler in the primeval forest discovered that, by tying to the end of a stick the stone destined to crack the skull of his enemy, he could make the crack more surely deadly, his inventive genius, sign as it is of his high rank among the creatures, has been busy over this problem. How to strike, with fatal effect upon his foe and with safety to himself has been his study and he has given birth to many an idea tending more and more from age to age to enable him to do his work by mechanical contrivance.

It is curious that crudities still appear in the weapons which the geniuses of centuries have labored to perfect and that our eyes should be opened at this late day to almost ludicrous imperfections in our most cherished killing machine, the rifle. Yet it is only a few years since the smoke of black powder was done away with and comparatively a matter of days since young Mr. Maxim produced his sound-choking, flame-suppressing device. And now comes news from Sweden than an inventor there has found means, at last, to stop the kick which has made sore shoulders from the time the first blunderbuss was discharged, and has constructed a weapon that will drop men so fast that a single marksman may dispose of a regiment in an hour.

Eleven hundred and twenty-five shots to the hour from a gun that is carried in the hand and fired from the shoulder is a high record. If that gun is smokeless and kickless, it is convenient to handle and but little trouble to operate. Inventive Mr. Sjogren has made a distinct subtraction from the demerits of the rifle from the standpoint of the user, for his new gun has made this record and has the new feature. And the weapon has already taken rank with the most approved and will doubtless become a part of the armament of many of the world's armies.

It is a curious condition under which to work, when an inventor finds that, for the purpose of applying his own new ideas, he must discard the improvements which have been made by his predecessors upon the particular machine he aims to better. With Sjogren, the very appliances and perfections of modern guns were faults, in that they made such complication of delicate mechanism as to render additions next to impossible. He tried and was discouraged by the intricacies of modern arms and, as a result, he turned back and away from them altogether, and took up the simpler primitive rifle, or rather made a new gun altogether for his purpose.

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Top View of Mechanism with Breech Block Cover Removed.

View of Breech Mechanism with Block Cover Removed, and also Bolt-Lock Piece.

A Clip of Five Cartridges for the Magazine.

The Inner Side of the Breech Block Cover with Firing-Pin Cocked.

THE NEW SJÖGREN AUTOMATIC NON-KICKING RIFLE.
Weight, 8¼ pounds; length, 46 inches.

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His first idea was not of a weapon for war, be it said, but for sport, and the first rifle he produced was a sportsman's arm. It was only when two of the powers, alert for new military engines, saw the possibilities of the device in warfare, that he took up the adaptation of his idea to that field. It is essential, therefore, that in an attempt to understand the new gun and its operation, one should forget what he already knows of the construction of other modern weapons, and get down to fundamental principles.

If a block of wood is suspended in the air by its ends and a second block is placed upon it without fastening there, a smart blow may be struck upon the end of the under and supporting block without greatly disturbing the upper one. Inertia, or the tendency of the untouched block to remain at rest, despite the friction of its side against the lower block, reduces its response to the disturbance to a minimum. This is the principle which the inventor used in constructing his gun. The barrel may be likened to the supporting block, and the heavy breech-block cover, a freely moving body, to the other. The motion of the latter is, of course, limited to the needs of the arm, and, by aid of a spring, part of the energy of recoil is stored for use in operating the loading mechanism.

When the gun is fired, and the blow of the powder-gases strikes backward within the breech, a series of movements of the mechanism follows that may be described without technicalities. When the powder is exploded, the bullet is at once set upon its way out of the muzzle end of the barrel with a terrible push behind it. Its progress is impeded, however, by friction against the inside of the barrel and in the grooves of the rifling. It has, therefore, a decided tendency to drag the gun forward and away from the shoulder of the marksman. Since it moves with less resistance to the powder than the mass of the gun itself, moreover, it is actually forced on and out of the muzzle before the backward blow, or kick, of the gun can take place. The influence of its forward drag upon the barrel and the inertia of the weapon itself therefore delay the kick. In the new weapon, during the operation of firing, the breech is held firmly and absolutely closed because the firing-pin itself, in the very act of falling, secures and wedges into position the locking lugs. There is no possibility of fumes of the powder-gases escaping backward into the marksman's face, or of a premature release of the movable part. At the moment that the bullet's influence is ended by its departure from the muzzle, and the inertia of the gun itself is overcome, the backward kick begins. Now, however, as the firing-pin is no longer forced forward, the mechanism releases the breech-block cover, so that it may slide upon its bearings, in the same manner that the upper block slides, when the lower one is struck with the hammer; and, as the gun shows tendency to recoil, the breech-block cover slides forward, or perhaps better said, remains stationary, while the gun tends to move backward. Now, the heavy spring, so set as to bear between the main mass of the gun and the breech-block cover, receives the shock of the recoil, absorbs by far the greater part of it, and stores up energy. When, presently, the breech-block cover yields to the recoil pressure and to the influence of the spring and begins to slide backward toward the stock of the gun, its movement is utilized to open the breech, throw out the empty cartridge-shell, allow the fresh cartridge to be fed up from the magazine below, and finally to close the breech again and set the firing pin in a position for immediate re-firing.

The action is almost instantaneous, of course. Each operation consumes but an infinitesimal fraction of time but is distinct enough to be certain and to come only in its exact order in the sequence. Though it would be impossible for the senses to detect it, time really elapses between the pull of the trigger and the propulsion of the shot from the tube—during the pause of the breech-block cover at the instant of recoil, while the spring is receiving the shock and storing energy, while the breech is unlocking, the empty shell is being ejected and the new one coming up in its place, and finally in the succeeding locking of the breech. But it is all too quick for concurrent analysis.

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Military authorities are well pleased, also, with another feature of Sjogren's gun. It is impossible for premature firing to take place, because the simple, though important feature of the firing-pin operation prevents the release of the breech and also recocks the piece. The simplicity of the weapon, too, appeals to all who examine it. There is nothing about it that can be easily deranged as a result of hard and continued firing, and it has no unnecessary adjuncts which make its operation intricate. The complete weight, without bayonet is eight and a quarter pounds, and it carries a magazine holding five cartridges, loaded either in clips or loose. Its length is just two inches less than four feet.

It is claimed that much more accurate firing may be done with this gun than with any other type, because the absence of kick enables the marksman to hold his sight better upon the object of aim and because he does not become exhausted or worn in continued firing for long periods. The high number of shots that may be fired in an hour is due to the swift automatic reloading feature. It has been found, too, that a higher initial velocity is imparted to the bullet, this having been measured at twenty-two hundred feet per second.

Still another feature, and one which promises best for its immediate adoption in military circles, is that old arms can readily be converted into the new form. This means that many thousands of guns which might be displaced by the new one can be remodeled and the expense necessary is small in comparison to what it would be if the remodeling were impossible. A number of the powers have tried the Sjogren gun since its possibilities in the military field were first suggested and some of the tests are now going on. It is reported that they are proving satisfactory in every particular. Experimental rifles adapted to the system have shown greater efficiency than in the older forms and have given great satisfaction to the users. The men who have had the handling of them have been enthusiastic in their praise of inventor and invention. Officers in the British army go so far as to predict a complete rearming of the forces of the world with the new gun or an adaptation of its principles.

To say that it is the greatest and most revolutionary improvement in firearms since the introduction of automatic loading, seems not extravagant. This gun, using smokeless powder and fitted also with Maxim's sound-muffler and flame-quencher, will make a well-nigh ideal arm for all kinds of purposes. Battles of the future may have none of the recognizable features of those of the past and may be totally different affairs. But those who hope more for future international peace than for perfection of methods of destroying enemies, can also see new hope in such a terrible weapon as this combination makes. For it will become less and less possible to fight at all, as improvements of this kind gradually eliminate the necessity for human beings to take a hand in the fighting. When machines exist which are soundless, kickless and which make no demonstration which allows of their position being located; and when one man can hide and fire as many shots as a regiment without exposing himself to return fire, it will be utterly useless to put troops into the field, as troops are now handled. War will be the silent work of the invisible assassin, as a writer recently suggested in the TECHNICAL WORLD MAGAZINE, in discussing the Maxim invention. And if every fighting man adopts the same method, there will be nothing for anybody to shoot at, and the whole performance will become even more ridiculous and absurd than it now is. And it is a consummation devoutly to be wished.

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GREATEST FLEET NEEDS NO SUBSIDY

By Len G. Shaw

Seven times as much freight goes through the Sault Ste. Marie Canal during the six months season every summer as the whole world sends through the Suez Canal in a year. Though the merchant marine of the United States languishes on the high seas—for want, it is tearfully declared, of a government subsidy—the fleet which carries the vast commerce of the inland ocean is practically all built and owned in the United States and makes great fortunes for its owners —without begging the public which pay its expenses.

STANDING beside the writer on the dock at Quebec one day was a grizzled old captain who, for twenty years in command of some of the fastest passenger and freight steamers on the Great Lakes, was getting his first touch of salt water navigation.

We were watching a transatlantic liner enter port, and as the vessel crept toward the pier with snail-like pace the fresh water sailor's impatience increased.

"Must have a fine captain, coming in like that," he commented aloud, unmindful of the fact that he was amid strange surroundings.

"It's the pilot that's bringing her in careful like," volunteered one of a group of officials awaiting the docking of the vessel.

"Pilot be blowed!" burst forth the veteran of the lakes, unable to longer restrain himself. "Say, if I ever had a deckhand who couldn't bring a boat in quicker 'n that I'd kick him and his dunnage overboard."

On the spot the man from the Great Lakes was made a member in good standing of the Ananias Club. He realized this from the contemptuous grins of those about him, and it only stirred his wrath anew. Delving into an inner pocket he brought forth a crumpled bit of newspaper and shoved it under the noses of those who would discredit him.

"Read that," he commanded, with the air of one accustomed to being obeyed.

It was a ten-line item from Duluth, recounting in the most matter-of-fact way how in seventy minutes a steamer had taken on 9,277 tons of iron ore there, being in port all told but a trifle over two hours.

"That lubber you fellows call a pilot couldn't make a landing that quick," sniffed the fresh water mariner contemptuously. "There's another."

The second was a dispatch from Conneaut, Ohio, telling that a steamer had unloaded 10,346 tons of iron ore there in a trifle over four hours, an average of better than forty tons of ore being lifted from her hold every minute the operation was in progress.

"That's the way they do things up there on the lakes," he snorted defiantly, folding up the bits of paper and stalking away.

It was the spirit of the Great Lakes as-

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THE WONDERFUL ORE DOCKS AT ESCANABA, MICH.

serting itself—the spirit that has overcome seemingly insuperable obstacles and developed a commerce of astounding proportions, yet of which the nation at large has little realization; that, unaided by subsidies or other artificial means, battling against the keenest competition, has built up a merchant marine the like of which is not to be found flying the American flag elsewhere, and which is yearly adding to the tonnage capacity of American bottoms more than all other shipping interests in the country.

The fiscal year ending June 30 last was the banner one in the history of American shipbuilding. During that period 1,056 vessels were built in the United States, according to government reports, of which seventy-five were launched on the Great Lakes. Not a very favorable showing for the lakes? Wait a moment. These 1,056 vessels had an aggregate gross tonnage of 582,627, and of this the seventy-five on the Great Lakes contributed 304,379, or considerably more than half.

Forty-five of these were what are known as coarse freighters, designed for expeditious handling of ore, coal and grain. They represented an investment of $10,000,000, and a conservative estimate places the total cost of the seventy-five at $15,000,000.

When this fleet of forty-five vessels leaves Lake Superior downbound, and there are plenty of ports where all could load in twenty-four hours without crowding, it carries enough iron ore to build a score of Dreadnoughts. In a little more than four days after casting off the lines at Duluth or other Lake Superior ports you could find this same fleet tied up at the docks down on Lake Erie, eight hundred miles from the starting point. Another twenty-four hours, and with all this ore transferred from their holds to the docks, these ves-

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sels would be racing northward again, carrying sufficient coal to send this same score of Dreadnoughts steaming around the world, with enough fuel left at the end of the journey to furnish a good start on another trip. In less than a week's time they might be speeding southward with enough grain aboard to provide bread for the entire complement of officers and men required to man these Dreadnoughts on their globe circling trip.

A COMBINED FREIGHTER AND PASSENGER.

Every time one of these freighters leaves the ore docks it carries on an average 9,000 tons of iron ore. Some of the vessels carry less, but the 10,000 ton freighter has become so common that it no longer attracts attention.

The average freight rate on every ton of iron ore passing through the locks at Sault Ste. Marie on its way to lower lake ports was, in 1907, sixty-seven cents. The charges for transporting this ore by rail the same distance would be approximately seven times as great. That means that on every 9,000 ton cargo brought down to Lake Erie or Michigan ports the public is saved $36,180 over what it would have to pay were it not for this means of bringing the products of the mines to the mills.

Steel is indispensable in this day and age. We all have need of it in some form or other, even though in small quantities. In a single season there has passed down from Lake Superior a total of 39,594,944 tons of iron ore. Figuring on the above basis, this means that, in the six months navigation was possible on the Great Lakes, vessel owners, in addition to earning comfortable dividends, saved the nation close to $160,000,000! Of course this little matter of two dollars for every man, woman and child in the country was not disbursed directly, but the levy that under other conditions would have been imposed was avoided.

There is another, and an even more vital factor, that figures in this lake commerce, a commodity which touches the pocketbook of rich and poor alike. Of wheat there passed through the canals at Sault Ste. Marie in a single season 98,135,775 bushels, or approximately one and one-quarter bushels for every person in the country. Millions of bushels were also shipped by water from Chicago, materially increasing the total. The freight rate on wheat from the head of the lakes was a shade less than two cents a bushel. Adding to this the cost of transshipment by way of the Erie Canal and the charge by boat from Chicago or the head of the lakes to New York was approximately five and one-half cents. The rate by rail from Chicago to New York averages a trifle over ten cents a bushel. It requires no skilled mathematician to see that at a very conservative figure the breadwinner, who is

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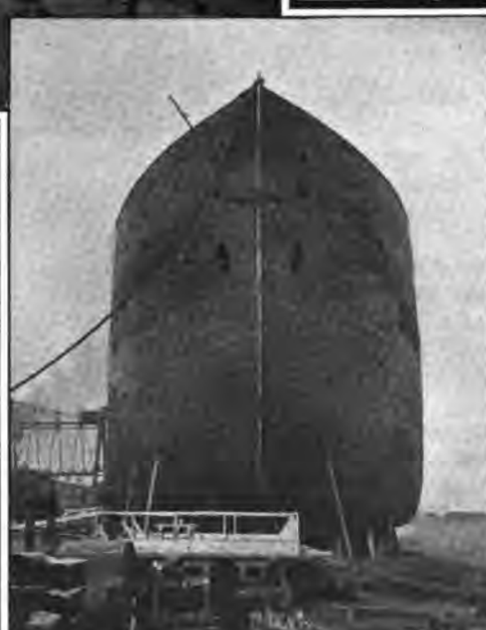
the one directly affected in such matters, saved on the one hundred and twenty-five million bushels of wheat transported by water not less than $6,250,-

EARLY STAGE IN THE CONSTRUCTION OF A LAKE LEVIATHAN.

AT WORK IN A COMPARTMENT IN THE HULL OF A FREIGHTER.

000! And who can say what the charges might have been had it not been for the competition afforded by the lake lines?

Through the locks at Sault Ste. Marie there passes in the course of six months, each summer, seven times the tonnage all the rest of the world sends through the Suez Canal in a twelvemonth. The Detroit River makes a showing fully twenty per cent higher than Sault Ste. Marie, the



BOW OF A FREIGHTER ON THE WAYS.

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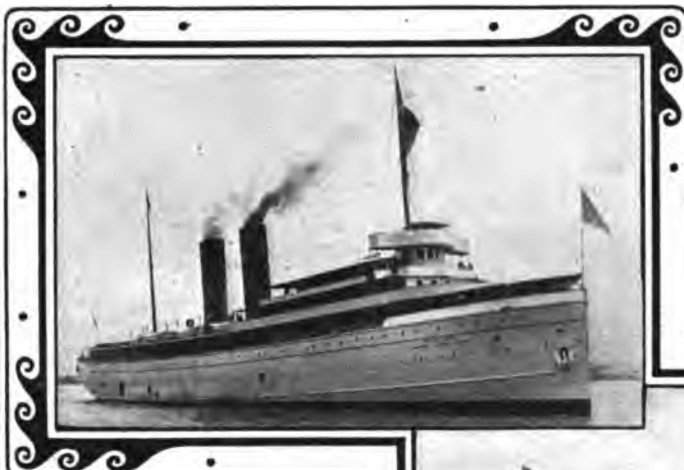
record for a single season being 71,226,-895 tons, the value of this freight exceeding $700,000,000.

In transporting this vast tonnage there were employed 1,215 vessels, representing an investment of $120,000,000, or more than the value of all other American boats. That isn't all, either. On the upper lakes and sailing out of Chicago and other ports are massive freighters and palatial passenger steamers, that do not get down as far as the Detroit River, adding several millions of dollars to the investment, and increasing the tonnage proportionately.



A Magnificent Exclusively Passenger Steamer of the Great Lakes.

One Type of Lake Passenger Steamer

At a conservative estimate, 80,000,000 tons of freight are carried on the Great Lakes in a single season. When you come to consider that all this traffic, representing one-third of what is annually transported in American bottoms, has to be handled in a trifle over six months you begin to understand why steam has displaced sail, and why methods for handling freight have been reduced to a science that makes salt water sailors gasp with astonishment.

Offhand, 160,000,000,000 pounds seems quite an amount. If transported by hand it would mean that every person in the United States would be called upon to carry a little matter of 2,000 pounds. Only when these figures are analyzed does their true significance become apparent, however. Loaded in thirty ton lots, 2,666,666 freight cars would be required, making a train the caboose of which would just be leaving Jersey City westbound as the locomotive crossed the East River on its triumphal entry into New York after circling the globe. Divided into trains of forty cars each, to move this vast tonnage would require the services of 66,666 mogul locomotives, and an army of not less than 330,-000 trainmen.

On the lakes all this freight is handled without fuss or flurry. A vessel steams into port, and its arrival is noted by the local press, three words usually covering the vessel, cargo and the port from which it sailed. More likely than not the arrival and departure appear simultaneously in a late edition. Even the people closely identified with marine interests on the Great Lakes have little appreciation of what is taking place daily; the outside world knows nothing.

Naturally one wonders how, even with such great tonnage available, vesselmen manage to eke out an existence when there is such a discrepancy between their rates and those charged by the railroads. The fact remains that

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SAID TO BE THE LARGEST GRAIN ELEVATOR IN THE WORLD.
At Port Arthur, Ontario. It has a capacity of 7,000,000 bushels.

they not only exist; they become wealthy. In few if any other lines of activity has the rise to riches been more rapid, or more spectacular, than among these captains of industry who preside over the destinies of great fleets of vessels on the inland seas. They have built up a merchant marine which should be the pride of a nation that knows little or nothing regarding it. They employ American officers and American crews, pay wages unheard of on the high seas, give their employes quarters on shipboard that would make a salt water sailor certain the millenium had arrived, tie up their vessels for six months in the year, and still make plenty of money.

How? By reducing the handling of freight to a science, and eliminating every bit of waste. Nowhere else on earth are cargoes handled with such speed as on the Great Lakes. Comparatively little of the immense volume of traffic transported by vessel interests originates or ends with them. From the mines of Minnesota and Michigan the iron is carried by rail to the lakes. At the other end of the line it may be picked up again by the railroads and transported to furnaces hundreds of miles away.

The fertile fields producing the millions of bushels of wheat and other cereals annually finding their way to market by way of the lakes, and which keep the nation's breadbasket filled at a considerably lower cost than would otherwise be the case, are hundreds of miles inland. Their golden wealth must be loaded in freight cars and sent to lake ports, there to be transferred to elevators, and in turn to the vessels awaiting a cargo. Again, hundreds of miles to the south, the railroads take up the task where the vessels leave off. The same is true of coal and other commodities that are circulated through these channels.

The facilities for handling freight are a revelation even to those accustomed to seeing things done on a large scale. In the magnificent harbors of Duluth and Superior, but a few miles apart, the entire lake marine could find shelter if needs be. Duluth has ore docks that are marvels, one possessing a storage capacity of close to two-thirds of a million tons. Its grain elevators hold more than forty million bushels, and two thousand vessels annually enter and clear from the port. Superior has a dozen elevators that can handle 17,500,000 bushels of grain at one time, and its coal docks have a capacity of 3,000,000 tons. Into this

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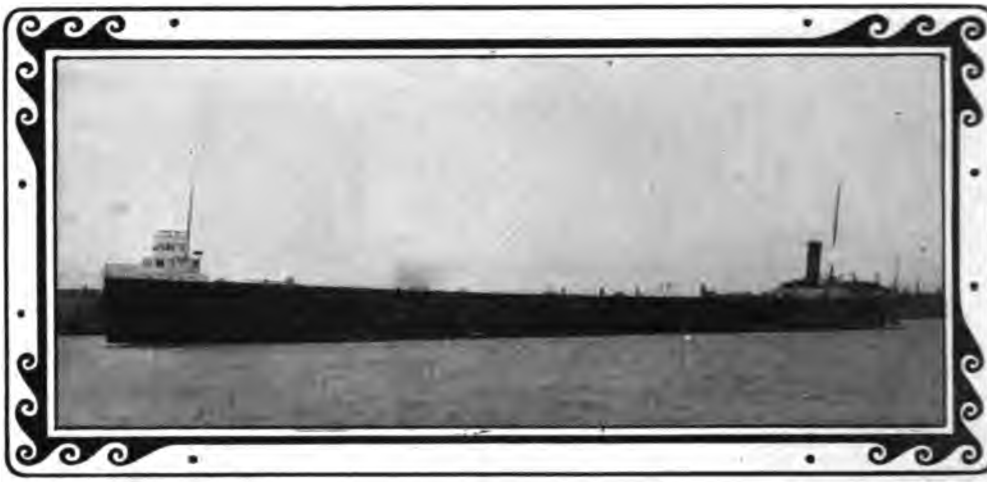

A TEN-THOUSAND TON FREIGHTER OF THE GREAT LAKES.

port a score of the largest freight steamers could slip, discharge their cargoes of coal, take on iron ore and steam away without causing the slightest congestion.

At Marquette the ore docks of the Duluth, South Shore & Atlantic Railway extend out into Lake Superior a quarter of a mile, tower seventy-four feet above the water, contain four hundred thousand feet of lumber, and cost $4,000,000. Here it is possible to load the largest vessels in a few hours, while the cargoes taken aboard make no appreciable difference in the mountain of ore still awaiting shipment. The Cleveland Cliffs Company has similar docks at Marquette, into the pockets of which trainload after trainload of iron ore can be dumped and leave room for as much more.

Escanaba, over on Lake Michigan, has ore docks where thirty steamers could load at one time.

At Port Arthur and Fort William, on the north shore of Lake Superior, are elevators where two score grain carriers could take on cargoes without entirely removing the stock. At the former city is located the Canadian Northern tile tank elevator, the largest in the world, with a capacity of 7,000,000 bushels of wheat, or enough to supply every man, woman and child in the United States with two and one-half one pound loaves of bread. And before this wheat could be turned into flour, much less baked into bread, the elevator could be refilled again and again, for the three Canadian provinces of Manitoba, Saskatchewan and Alberta alone produce in one season 90,000,000 bushels of wheat, a large proportion of which finds an outlet by way of the Great Lakes, as does that of Minnesota and the Dakotas.

There are other ports in plenty where similar accommodations are provided, but words fail when it comes to describing what takes place here. A six hundred foot freighter steams up to the dock. The score or more hatches are opened, and almost before the last lines have been made fast unloading machines are busy with the cargo of coal. With a mighty din the operation continues uninterruptedly until all has been removed. A short shift to another dock, and the work of loading begins. Viewed from a distance the ore docks look like giant trestles. Upon closer inspection you find they are a series of compartments or pockets, several score in number, open at the top, and with a chute leading from the bottom of each. Along the top of this trestle that, gaunt and ugly, stretches up from the water fifty to seventy-five feet, run railroad tracks. Down these, or up, as the case may be, ore laden freight cars from the mines are run, their hoppers opened, and the ore they have brought joins the waiting mass below.

As soon as the steamer in quest of a

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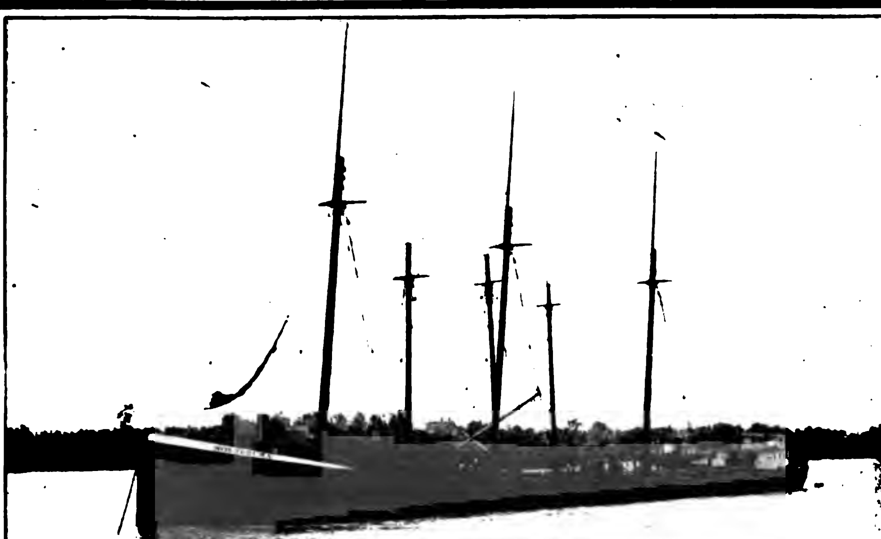
cargo has made fast to the dock a chute is run into each of her hatches, be they a dozen or a score. The doors are opened, and with a dull roar the red flood begins the downward descent from the pockets to the hold of the boat, that is not checked until the vessel is loaded. It is all over in a few hours at the most. The hatches are battened down, the captain takes his place on the bridge, lines are cast off, and with a blast from its sonorous whistle, the steamer bearing three hundred carloads of iron ore, swings about and starts on the journey that will end at a lower lake port hundreds of miles away. And up above, on the trestle, trainload after trainload of ore is being dumped into the hungry maws as another steamer moves up to take the berth just vacated—for far to the south are greedy furnaces whose insatiate cravings must be appeased.

At the grain elevators much the same scenes are enacted, save that here the cars are unloaded by means of great "legs" consisting of endless chains of buckets that carry the grain aloft, to be loaded from the bins above into the vessels by gravity.

All this is done without ostentation, but the results are marvelous. It is a matter of record that eight thousand tons of iron ore have been put aboard a freighter in one hour, and loading three hundred thousand bushels of grain is a matter of only a few hours.

Even more astounding is the showing made at lower lake ports, where ore cargoes are discharged. Putting ten thousand tons of iron aboard a vessel by gravity is simple compared with the labor involved in removing the same amount. Inventive genius and the exigencies of marine transportation during a season that lasts only a few months have solved the problem. Tying up at the dock at the end of her journey, the steamer's hatches are opened. Into these are thrust the long arms of a gigantic unloading machine. High up on the spider-like trestles that constitute the framework of the unloader engineers await the signal. Once it has been given the machinery is started and the ore brought forth at a rate which seems incredible. What can be accomplished in this direction was shown by the steamer *George W. Perkins,* which at Conneaut, Ohio, discharged 10,346 tons of iron ore in four hours and ten minutes.



THE *MONTEZUMA.* ONE OF THE OLD-TIME TOW BARGES OF THE GREAT LAKES.

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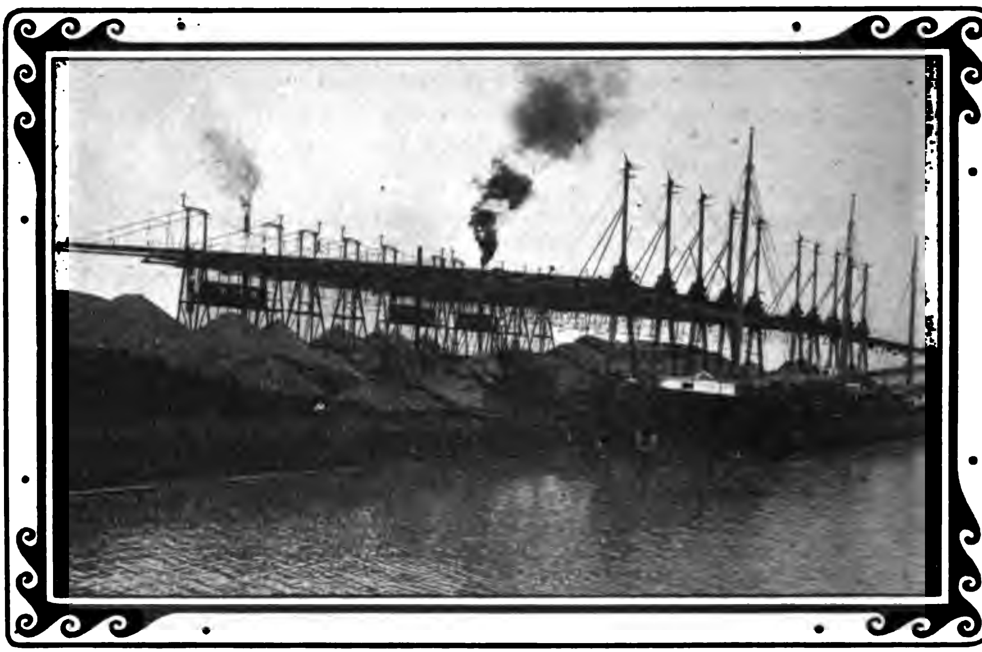
When you are dealing in trainloads, every minute saved in handling a cargo means increased dividends. They deal in trainloads on these inland seas, too. Take for example the steamer *J. P. Morgan,* which on a single trip down from Lake Superior carried 13,800 tons of iron ore. This was not necessarily a record cargo, but it meant that in the hold of this one vessel there were ten trainloads of ore, to be exact, four hundred and sixty thirty-ton cars.



GIGANTIC FRAME-WORK OF ORE UNLOADERS AT ASHTABULA, OHIO.

One day the steamer *L. S. DeGraff* left Chicago with 421,000 bushels of wheat, the cargo weighing 12,661 tons. A half dozen lines in the papers served to tell the story. At almost the same time in Tacoma and other coast cities great todo was made because the British steamer *Aparina* had broken the Pacific grain carrying record. Yet the *Aparina* when she left Tacoma carried only 273,636 bushels of wheat, or 8,240 tons, her cargo being fifty per cent less than that of the *De Graff.*

In a single day there were locked through the canals at Sault Ste. Marie one hundred and twenty-one vessels, having a registered tonnage of 237,385, and carrying 487,649 tons of freight, figures calculated to make those prone to scoff at the Great Lakes sit up and take notice. For the season of 1907 the cargoes passing through the locks at the "Soo" were valued at $569,830,188.

They build ships on the Great Lakes with the same speed that they handle cargoes, and on the same comprehensive scale. There are no less than a dozen large ship-yards located about these inland seas. If you want a ten-thousand-ton freighter you can get it in ninety days after the keel blocks are put in position. The feat has been accomplished in a trifle more than half this time, but it was exceptional. What is more, when that vessel is turned over you have the satisfaction of knowing money could buy no better; that it is complete in every detail, and capable of sailing where any boat dares venture.

The same is true in regard to the floating palaces engaged in the passenger business. No more luxuriously appointed vessels can be found than those that operate between lower and upper

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PASSENGER STEAMER IN DOCK AT DETROIT.

lake ports. You can board a steamer in Buffalo and on the sixth day be back at the starting point, having covered the two thousand miles to Duluth or Chicago and return, with stops at intermediate ports. And on these and scores of other trips you travel with all the comfort that can be found on a transatlantic liner. There is running between Detroit and Cleveland a steamer that among other features embodies elevator service to each of the seven decks, washed air ventilation in every stateroom, a convention hall where large gatherings may be held and a private telephone system which in conjunction with the wireless telephone with which the vessel is equipped makes it possible to communicate with land at will. There are scores of boats but a trifle less pretentious, on which one may journey at a ridiculously low figure when all things are considered.

The records of the men, who have made these things come to pass, outrival fiction, although there is little but pluck and perseverance to which their success can be attributed. What they have accomplished has been done in the last twenty-five years or less. In 1884 the total freight passing through the Sault Ste. Marie locks was 2,874,551 tons. In 1907 it reached the tremendous total of 58,217,214 tons. The same year 71,226,-895 tons of freight valued at more than $697,000,000 was carried through the Detroit river, vessels passing the city on an average of eight minutes apart during the season when navigation was possible.

To enumerate the men who have made good would be to include all identified with marine interests along the Great Lakes. From the great vikings of the unsalted seas, down through the captains and mates, the sailors whose stay in port is so brief they seldom leave the vessel, the grimy stokers far down in the hold, the ore covered laborers on the docks, they will tell you it is all in the day's work; that there is nothing romantic about the part they play. There is plenty of hard labor—but there is more than that. The constant rush and hurry, the high tension under which they toil, the realization that big things are being accomplished, that they are a vital part of the great throbbing machine, gives irresistible fascination to a life that at

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FOUR MILLION DOLLARS' WORTH OF LAKE FREIGHTERS IN WINTER QUARTERS AT DETROIT.

first thought seems insufferably dull. The lure of the lakes they call it, this indefinable something that prompts men to undertake great things and carry them through to a successful conclusion, and which has resulted in the building up of a merchant marine on the Great Lakes that, little known outside the immediate district in which it operates, has no equal elsewhere in the nation, and should cause every patriotic American breast to swell with pride.

After

How he lies in his rights of a man!
Death has done all death can.
And absorbed in the new life he leads,
He recks not, he heeds
Nor his wrong nor my vengeance; both strike
On his senses alike,
And are lost in the solemn and strange
Surprise of the change.

—Browning.

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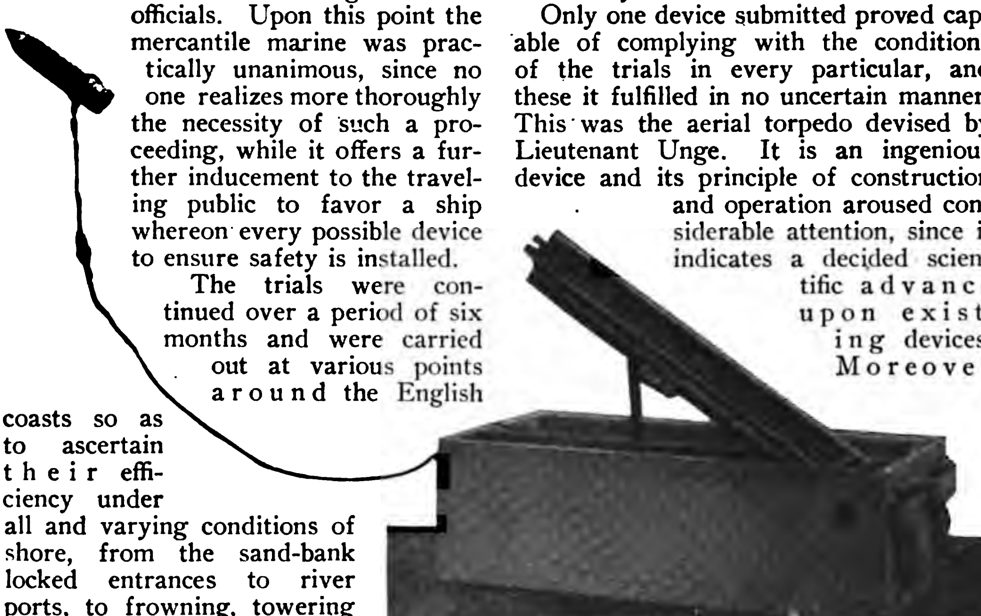
TORPEDO TO SAVE LIVES

By CECIL BEMBRIDGE

UNDER the pressure of public opinion the British government has recently initiated a series of tests with improved life-line throwing devices. Inventors of all countries were invited to submit the fruits of their inventive labors and such devices were to be given a searching trial. But there was one important stipulation. Recent disasters have shown that the minimum range of any such apparatus should be far in excess of the limits of the rocket, and this was ultimately fixed at three hundred yards. At the same time opinion was sought among the shipping community as to the advisability of compelling all vessels flying the British flag to carry a life-line throwing apparatus that had proved its all round efficiency to the satisfaction of the government officials. Upon this point the mercantile marine was practically unanimous, since no one realizes more thoroughly the necessity of such a proceeding, while it offers a further inducement to the traveling public to favor a ship whereon every possible device to ensure safety is installed.

The trials were continued over a period of six months and were carried out at various points around the English coasts so as to ascertain their efficiency under all and varying conditions of shore, from the sand-bank locked entrances to river ports, to frowning, towering cliffs fringing an ill-reputed treacherous rocky and exposed shore. The tests were followed by the writer and one striking point startlingly forced its way to the front. That was the trying character of the minimum range imposed in the tests, and the inability of inventors to realize the difficulties prevailing. The inventions submitted were of an extensive and varied character comprising kites, drifting buoys, cannons hurling projectiles to which a life-line was attached, and rockets. Kites proved unreliable being entirely at the mercy of the wind; drifting buoys were somewhat erratic and perforcedly slow; rockets failed in their range; while cannons proved useless since in order to cover the requisite distance with unerring accuracy, such a high muzzle velocity had to be imparted to the projectile that the life-line was snapped, and when this accident did not occur they failed to cover the three hundred yards.

Only one device submitted proved capable of complying with the conditions of the trials in every particular, and these it fulfilled in no uncertain manner. This was the aerial torpedo devised by Lieutenant Unge. It is an ingenious device and its principle of construction and operation aroused considerable attention, since it indicates a decided scientific advance upon existing devices. Moreover



PROJECTILE REPRESENTED AS IN FLIGHT.

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it is entirely self-contained and can be transported from one point to another with facility, and is as efficient in its application upon the deck of a ship as upon *terra firma*.

It comprises a pointed cylindrical shell about twenty inches in length by four inches in diameter. In the lower part is carried the most important feature of the apparatus—the miniature powerful turbine which not only imparts the propelling motion to the missile, but also gives to it the rapidly revolving action about its longitudinal axis whereby accuracy of flight is insured. It is practically a scientifically designed rocket only without the encumbering tail or stick. The turbine is driven by the gases generated by the combustion of a special compound carried within the body of the shell. This compound is composed of sulphur, charcoal, saltpeter, and vegetable oil, and is a kind of black powder. It is, however, inexplosive, burning more like a vicious fuse and generating a considerable amount of powerfully expanding gases, which in their effort to escape through the base of the shell, have to pass in a slanting direction through the blades of the miniature turbine.

The special feature of this combustible charge is that it is made so hard that it cannot possibly be ignited without recourse to a fuse or electric spark. Neither can it decompose or spontaneously ignite, owing to the presence of the vegetable oil. This latter ingredient also insures its preservation for any length of time irrespective of temperature or climatic conditions, so that no matter how long a torpedo may be carried on board ship before it is called into service, it is certain to be as effective as upon the day when the shell was first charged.

General View of Apparatus Complete.
Showing torpedo in firing position in cradle and life-saving rope alongside.

In the majority of torpedoes used for military purposes the projectile is fired from the base, but in this case this operation is effected from the front or nose. Moreover it is fired from an open trough like cradle. The whole equipment is stowed in a small box, which mounted on wheels, allows removal from one point to another to be easily carried out while the whole can be secured by means of shackles. The box in which it is carried in addition to containing the launching cradle (hinged at the lower end and capable of inclination to any desired angle) and torpedo, carries 500 yards of one-inch rope havirg a breaking strain of about two tons, coiled on a rack in such a way that it pays out rapidly without any fear of fouling or becoming entangled. The life line is attached by a swivel joint to a stout metal ring or collar which is placed freely on suitable mountings at the muzzle of the launching cradle in such a manner that when the torpedo is fired it passes through this ring, catching it up in its flight. It is prevented from traveling completely through it by a thick

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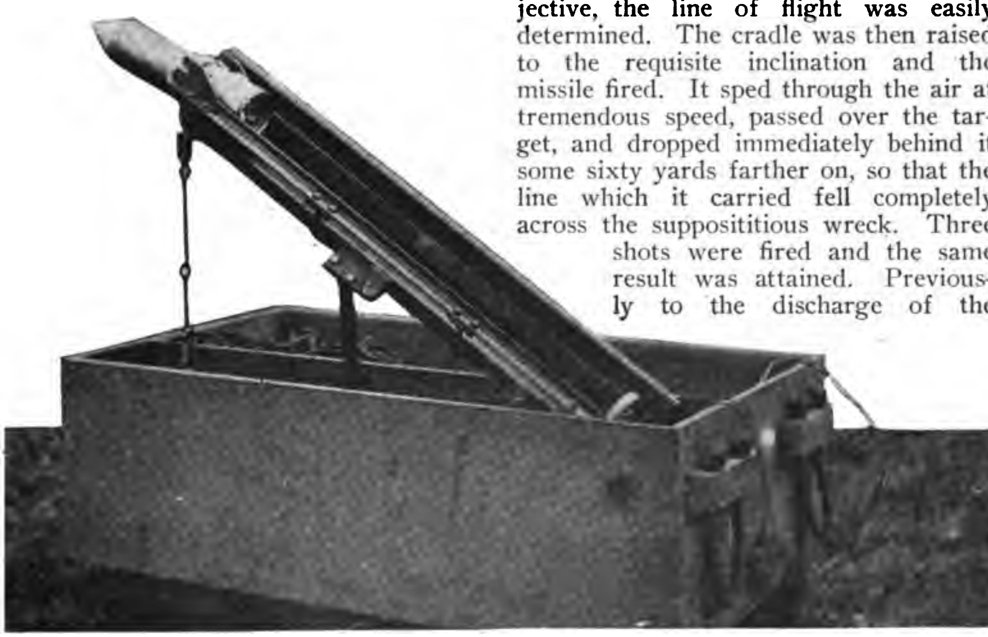
band encircling the shell near its lower end. The ring, however, is made of larger diameter than the shell so that the latter can rotate freely within it and the line does not consequently become twisted.

The firing operation is very simple. The torpedo is laid at the lower end of the launching cradle and two electric wires are connected with a sliding contact piece which is swung round so as to rest upon the nose of the shell. The operator carries a small electric battery slung over his shoulder and by sharply turning a small handle generates a powerful electric current which gives a spark at the make and break in the nose of the missile, thereby firing the charge. Instantly a volume of powerfully expanding gas is produced which in escaping sets the turbine in motion so that the torpedo travels up the cradle with increasing velocity, passes through the life-line ring, picking it up in its travel, and speeds through the air. When the combustion charge becomes thoroughly ignited, which is after the shell has traveled some forty feet, the turbine revolves at very great speed imparting a high velocity to the shell which flashes through the air like a meteor with its tail of flame trailing behind. This adds considerably to the value of the invention since on a dark night the operators can follow the path of the projectile until it strikes its objective and thus ascertain very easily whether the shot has been successful or otherwise.

In the trials the accuracy of the system was strikingly demonstrated. The target was 300 yards away, and by means of the arrow painted on the exterior of the containing box, which the operator pointed in the direction of the objective, the line of flight was easily determined. The cradle was then raised to the requisite inclination and the missile fired. It sped through the air at tremendous speed, passed over the target, and dropped immediately behind it some sixty yards farther on, so that the line which it carried fell completely across the supposititious wreck. Three shots were fired and the same result was attained. Previously to the discharge of the

FRONT VIEW OF SHELL JUST AFTER DISCHARGE.



THE TORPEDO AS FIRED.
It is just passing through and picking up life-line ring at muzzle.

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Unge torpedo, no missile fired by the other devices had succeeded in reaching the target at the stipulated distance with its life-line. Neither head nor cross winds affect the torpedo's range or accuracy of direction, a result due to its rapidly spinning and propelling action.

The efficiency of the apparatus was thus conclusively shown since the range requisitions were fulfilled. But a further advantage of the device was then exhibited. Instead of the line thus thrown being merely a pilot light-line which is used for hauling in a heavier hawser for supporting the breeches buoy, it can be anchored and the rescue carrying apparatus brought into service immediately.

This is a distinct advantage since it obviates any loss of time possibly at a critical period. Inasmuch as it was the only apparatus which complied with the official requirements in all particulars there is no doubt but that it will be adopted. Furthermore as it can be used for communicating between ship and shore, ship and ship, up to a distance of three hundred and sixty yards with equal success, its compulsory adoption on British vessels of all descriptions will doubtless be effected by legislative action.

TUMBLERS MADE OF ICE

By DR. ALFRED GRADENWITZ

Berlin Correspondent Technical World Magazine

ICE would at first sight seem to be the most unsuitable substance to make tumblers from. Still a Dutch engineer, H. G. T. Huizer, has proved the contrary.

In working out his process Huizer has endeavored to perfect a tumbler which might present the drink in as agreeable a form as possible while complying with all requirements of hygiene. The ideal, from the latter point of view, would obviously be a cheaply produced tumbler of ephemeral existence which after having once been used, would have to be thrown away, its destiny being fulfilled.

Now, the ice tumbler complies most perfectly with all these demands. It has a conical wall three millimeters in thickness, which, however, grows slightly thicker in its lower part, being rounded off towards the bulb-shaped bottom, of three times greater thickness.

A PRACTICAL CUP OF SOLID ICE.

The special form of the bottom has been chosen in order to prevent the tumbler from cracking or bursting off the bottom. The gradual thickening of side walls was adopted with a view to allowing for the increased melting of the tumbler in its lower parts—due to the higher liquid pressure and longer contact of the drink.

The tumbler will hold one-half pint of liquid and its store of cold assures to the vessel and its contents a really surprising life. The process of manufacture makes the otherwise porous ice impervious to water, especially after adding some minute amounts of inoffensive viscous matter.

The freezing mould is made up of two parts, namely, the outside mould and the inside core, in the space between which the ice tumbler is produced. The lower part of the core contains a cavity.

After a given amount of water has been introduced into the mould, the core is placed in position, when the

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water rises into the conical space and fills it.

The mould is then suspended inside the freezing solution in a refrigerating reservoir where, owing to the small thickness of the tumbler, congelation occurs very rapidly in regular layers. As the conical mould gradually tapers towards the top, the upper edge freezes first, locking in the remaining water, which then freezes gradually in a downward direction, alongside the wall of the core. The expansion which attends congelation drives the water into the cavity at the bottom, whence the last air bubbles are allowed to escape. The bulb of the tumbler bottom is thus produced automatically, preventing the enormous molecular force of expansion—the volume of freezing water is known to increase by one-tenth—from destroying the tiny mould. As soon as the tumbler is ready it is removed from the reservoir together with the mould, by seizing the handle.

Now in order that the tumbler may come off bodily from the freezing mould, the outside mould is made of special metal and the core of special porcelain. As the former expands more rapidly and the latter more slowly than ice, the tumbler if immersed in some luke-warm water, is detached from the mould bodily and perfectly dry. After being fitted into the protecting paper sleeve, it is finally detached from the core.

The Freezer in Which the Ice Cup Is Made.

This process has been found extremely simple in practice, the various operations being performed in a few seconds. The cost of manufacture is less than half a cent per tumbler, and the product is very satisfactory.

Wasted Advice

Ah, gentle dames! it gars me greet
To think how monie counsels sweet,
How monie lengthened sage advices,
The husband frae the wife despises.

—Burns.

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SNOW AND ICE COVER THE MOUNTAIN SIDE IN VAST IRREGULAR MASSES.
The Hanging Glaciers of Vulture Peak.

FOR A NATIONAL GLACIER PARK

By KATHERINE LOUISE SMITH

UP in Montana, near the International Boundary, is a magnificent tract of land, little known save by the Geological Survey and occasional trappers and hunters. Congress has been petitioned to preserve this for a National Glacier Park. As its name implies, the Rocky Mountains, which here may be said to be the backbone of the continent, are capped with huge glaciers which cannot be equaled in the United States. At least forty glaciers have been located and from them spring waters that become streams flowing into Hudson Bay, to the Gulf of Mexico and the Pacific. The scenery is stupendous, for in this garden of the ice-gods are mountains over ten thousand feet high, wonderful canyons, lakes, rivers and forests, the whole covering an area of about fourteen hundred square miles. The Rockies practically cut this region in the middle from north to south.

This section has been pronounced by experts to be in every way suitable for a park preserve. The many lakes—there are at least two hundred and fifty ranging from ten square miles to a few acres in area—the rushing glacial streams, the huge ice fields which resemble white pyramids, the cliffs and precipices towering hundreds and thousands of feet make this proposed park different from any reserve set aside by our government. At present there are numerous passes

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RAINBOW PEAK AND GLACIER.

A LAKE APPEARING AMONG THE PINES LIKE A SPLASH OF WATER.
Scene in Vulture Pass.

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GOATHAUNT CLIFF RISES LIKE SOME HIGH NATURAL CITADEL.

through the ranges made by prospectors and animals and it is planned that these shall eventually become wagon roads so that this park, like the Yellowstone Park, may be open for the enjoyment of the people.

Of course the stupendous glaciers are its prime attraction but another feature is the presence of large numbers of wild animals and fish. On the highest peaks are found the beautiful white goat, further down on the mountain sides are the bighorn Rocky Mountain sheep and in the valleys are deer, moose, and elk. The grizzly has been discovered in all sections. If these are properly protected it is believed that there will be enough game to supply sportsmen for years to come and at the same time the animals will have a good breeding ground and a part reserved where they may obtain food the year around, and under all circumstances. In setting aside this area there is no danger that the people are losing ground that might be useful to them in other ways. It is suggested that arrangements can be made whereby the forests can through a system of forestry supply timber to those who wish it, and there is practically no agricultural land or area containing mineral formations of commercial value. The projectors and those who have seen the glaciers believe that such a park will be of great interest and benefit to the people at large. Railroads will, it is assumed, run near enough to make it accessible and a few main wagon roads and horse trails will lead to points of general interest. Eventually, there may be roads as excellent and as well kept as in the Yellowstone Park. If the bill is passed, and all nature lovers hope it will be, we will have saved for present and future sightseers one of the most magnificent primeval tracts in our country.

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REMARKABLE NEW WELDING PROCESS

By DARWIN S. HATCH

A REMARKABLE process, invented by Dr. Goldschmidt, of Germany, for welding iron and steel, has been attracting a great deal of attention in the engineering world. It is known as the thermit welding process, and is based upon the use of a mixture of iron oxides and powdered aluminum. When any part of this mixture is ignited, it goes on burning spontaneously at an exceedingly high temperature, and produces liquid malleable iron. No other process allows liquid iron to be produced so rapidly and with such purity, without any special apparatus, as does the thermit process.

In order to ignite the thermit, a special igniting mixture is used, very little of which suffices to start the burning of the thermit. So dazzling is the glow produced by the combustion, that the operator has to wear dark spectacles. The temperature is over 5,000 degrees F.

This process is used for welding, end to end, iron pipes and rods. An apparatus has been especially designed for this purpose, and is quite successful. After clamping the rods or pipes fast, a mold of cast iron is fitted around the joint, and the thermit is ignited in a crucible and poured into the mold. The liquid iron heats up the joint until it welds and, upon cooling, the excess material is hammered off. When this process is finished we have one continuous pipe of uniform strength. This process is used also for repairing holes or minor defects in castings or forgings. In this case the molten metal is poured into the flaw and the excess removed with a chisel. In repairing small pieces, what is

CAST-IRON SCREW-PRESS REPAIRED WITH RING OF THERMIT.

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called the automatic process is used, the broken or defective pieces are either replaced by similar piece of thermit iron cast on to the remainder, or by uniting the two parts of the fracture with the end of a ring of thermit iron.

Welding Street Railway Tracks By the Thermit Process.

Possibly the most interesting instances in which thermit has been used are those of the repair of ships. Broken stern posts have been frequently repaired by surrounding the broken part with a thermit iron ring and welding the two fragments solidly together. Resistance tests made on these welded stern posts for the German Lloyd Steamship Company have been so satisfactory that the process was officially sanctioned for use in such repair work. One of the illustrations shows the welding of the stern posts of a steamship. The value of this method is that vessels can resume their voyage after a very short stoppage, whereas a stay of many weeks in the docks is made absolutely necessary in cases where broken parts have to be replaced by new ones. This process is also obtaining an extended use for tempering armor-plate.

Repairing the Stern-Post of an Ocean-Going Steamship.

Perhaps the most important use of the thermit welding process is for welding on street railways. The rails are fitted into a clamp and at the joint are surrounded with a mold into which the liquid thermit is poured. The liquid metal then surrounds the head of the rail, raising it to a welding temperature.

After the rails have become welded and the material has cooled, the extra metal is removed with a chisel and the joint is smoothed up. The whole operation requires only a very short time, and results in a continuous rail which is almost as strong at the joint as it is at any other place.

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WEIRD FEATS OF WIRELESS

By FIELDING DRAKE

THINK of calmly standing on the sea shore and by means of a small key and no connecting wires being able to annihilate an entire navy. This has been rendered possible by the invention of a submerged torpedo propelled and controlled by wireless electricity transmitted by the wireless method—the work of Carl Abrahamson of San Diego, California.

The invention is so simple that wireless experts are wondering how they overlooked it so long. The propelling force is manipulated on the same principle as the wireless telegraph. Electricity is transmitted from aerial wires on shore to aerials supported by cork floats and connected with the propeller wheel of the torpedo, which is submerged. A current powerful enough to send a sixteen-foot torpedo, of the type used by the American navy, through the water at a speed of thirty-two miles an hour can be transmitted, says the inventor.

Control of the device is secured by magnets set on each side of the propeller and connected with the steering gear. These magnets are of different degrees of sensitiveness and are susceptible to varying degrees of power in electric currents. The steering is thus made possible by a variation in the amount of power sent to the torpedo.

The California man, however, was not the first person who carried on this work along these lines. M. Gustave Gabet, a French engineer, has devised what is described as a radio-automatic torpedo. The torpedo weighs four tons and is directed by wireless electricity. It can be kept running for hours. The inventor has demonstrated he can make it move backwards, for-

A Night Ascension 3:05 A. M. at West Adams, Mass.

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wards and in a circle, in any manner at will.

This device is said to be one of the most deadly yet conceived by the brain of man. It can be manipulated from shore, or the deck of a moving ship. One of its most important features is its wide radius of action. It is capable of maintaining a speed of fifteen knots an hour for five hours. Its apparatus is synchronized so as to receive the Hertzian waves only from the ship sending them and to refuse the impulses sent forth from the enemy's ship or shore station. When loaded the torpedo carries 1,000 kilogrammes of guncotton.

Another engine of destruction, the wireless balloon, has been produced. Charles J. Glidden, the famous aeronaut of Boston, is the man who has produced this novelty in America. He has erected a station in which is a powerful wireless receiving apparatus and a medium strength transmitter. He hopes to develop his idea until he can control an airship in its flight.

A Leader in Motor and Aero Sports.
Charles J. Glidden, who has twice encircled the globe in an auto, and who is an international balloon pilot.

Mark O. Anthony is another ingenius inventor in the field of wireless. He claims he can control any airship perfectly by means of a current of electricity transmitted without wires. He has demonstrated his ability to do this feat on a model. Directed with absolute precision from miles away, the airship can be poised above an enemy's fort or ship, and at the will of the man clicking a little key, its cargo of explosives can be dropped by the electric release of a lever.

Anthony has the entire airship covered with receiving wires. The secret of the invention lies in the fact that, in spite of the lack of connection with the ground, the ethereal waves are received and translated into action.

The possibilities of this invention are staggering. Entire cities and fortresses could be wiped out of existence in the twinkling of an eye and no power yet devised by man could stay the terrible destruction. The greatest navies ever conceived would be as mere playthings for this machine. If driven by wireless waves there would be practically no distance too great for these devices to work.

After contemplating these engines of destruction and the fearful havoc they would be able to make, it is restful to consider several other inventions the object of which is the saving of life instead of its destruction.

The control of running trains by wireless telegraphy took a step forward when the Union Pacific Railroad recently equipped one of its locomotives with united wireless telegraph instruments. With this device the train dispatcher may sit at his desk and send an order directly into the cab of the engine when it is running anywhere in the division. With this machine working, an end will come to the accidents resulting from some telegraph operator's failure to deliver a train order properly.

In an emergency, with this device in operation, the train dispatcher simply will touch his key and far out on the railroad line, in the cab of the locomotive rushing into danger, a gong will

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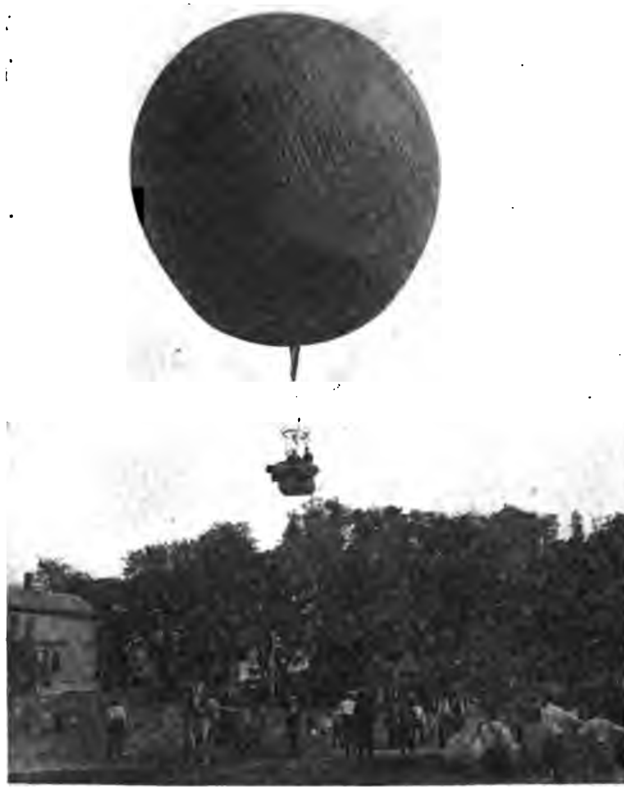
begin ringing and before the eyes of the engineer a red light will flash, while a miniature semaphore, painted red, will rise to the danger position and both the engineer and fireman will know there is deadly peril ahead for themselves and their train.

Only one locomotive has been equipped with this machine, but so well does it operate that it is only a question of time when the entire system will be fitted with the life-saving invention. With wireless stations along the line the dispatchers will be in touch with every engine on the road at all times.

But of greater importance from a life-saving viewpoint is the experiment recently tried on the Lake Shore and Michigan Southern Railroad, when with the use of a united wireless outfit, messages were exchanged between a rapidly moving train and stations.



CHARLES J. GLIDDEN MAKING AN ASCENT IN THE *Boston*.

The train equipped with an antenna strung along the entire length of the twelve cars, left Buffalo at 9:30 o'clock in the morning. It was found, owing to the fact that the aerial lacked height, it would be impracticable to send messages beyond any of the relay stations. G. Schaefer was the operator in charge of the instruments on the train. Eighty miles out of Cleveland he got in touch with the wireless station in that city. The train was going so fast the slightest curve in the track would throw the party of interested spectators watching the operator from one side of the car to the other. The train traveled three miles from the time the first tick was heard until the message was complete. The aerogram came clear and was easily received, without interference from the roar of the train.

Then Schaefer tried sending. The little barber shop, where the instruments were set up was filled with the noise and flash of the spark. With breathless interest the spectators crowded around as the operator adjusted his head 'phones. For a moment nothing was heard but the steady click of the wheels on the steel rails. The car swayed around a sharp curve. Then the operator's face lighted up with a triumphant smile.

"They got it," he cried. "Cleveland says he can hear us as plainly as if we were a regular land station. It's a go as sure as you're born!"

Schaefer was right. By this feat the attention of every railroad executive in the country has been attracted to wireless telegraphy as a means for safe-guarding life. Charles E. Daly, first vice-president and general manager of the New York Central lines, who watched the experiment, has announced

A Wireless Instrument Installed on a Special Train.
This was on a run made from Buffalo to Chicago, February 27, 1909.

that his company will install wireless telegraphy on the fast Twentieth Century Limited train at once.

To demonstrate more effectively his ability to transmit messages from a moving train, Schaefer got into communication with the station in Chicago. He received and sent, all told, 200 messages. At no time was the train out of touch with wireless stations.

It was in the brain of Arthur Mundy, of Boston, that the idea of a submarine bell for signalling between moving ships and between boats and points on shore was evolved. This invention is based on the fact that sound travels faster through water than through air. A submerged bell is attached to a steamship's side. The clapper is moved by electricity. A mechanical receiving device is also placed beneath the water's surface. One of these is on either side of the vessel, so that whichever one receives the message the loudest, is the nearest to the sending bell. In this way the ship's captain can tell in which direction the danger or distress signal is located.

By using the Morse telegraph code any desired message may be sent. Although the range of this device is not as great as that of the aerial wireless telegraph, it can be heard from fifteen to twenty miles.

But even in the field of regular aerial wireless telegraphy, wonders seem without end. Only recently Operator Jack Duncan in the united wireless station at Eureka, on the coast of California, received a message from the steamship *Ascunsion,* when it was more than one hundred miles at sea, saying a sailor had fallen from a ladder and was injured internally. The aerogram asked that a physician be consulted for advice as to how to treat the injured man.

The operator called upon a physician and explained the case. The doctor told him just what to do and Duncan hurried back to his operating room. He sent the doctor's orders to the ship at sea and the sailor was treated as directed, as if the surgeon were present. He recovered, and by the time the vessel reached port was able to step on dry land unassisted.

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ONE HUNDRED DOLLARS AN ACRE FROM CASTOR BEANS

By HARRY H. DUNN

Castor beans, at a gross profit of about $100 per acre, and an investment of almost nothing but his labor and that of one horse, is the crop which Herman Brass is growing successfully on a hitherto unproductive piece of land in southern California. The beans grow wild in the Southwest, and the seed costs nothing but the trouble to gather it, enough to plant twenty acres being gathered by one man in the course of an afternoon's work when the wild beans are ripe. The average price is five cents per pound and the demand is constant.

A NOVEL industry, yet one which is said by its owner to be very remunerative on small capital, has been quietly carried on in southern California for some time by an elderly German rancher, who brought the secret, if secret it can be called, from southern Europe, when he migrated westward several years ago.

Castor beans are the sole crop grown by this German, and for their growing he uses nothing but bare, semi-arid valleys and gently sloping hillsides, on which, owing to lack of water, nothing else will grow to good advantage. He supplies, of course, only a small part of the large quantity of castor beans in use in the world, but his is believed to be the only ranch of its kind in California, if not in the United States, much of the oil being prepared from the seeds of the wild shrubs, which grow in great profusion in some parts of America and Mexico.

At the beginning, Herman Brass, for that is the name of the castor bean farmer, planted seeds of the beans, obtained from wild plants, in rows five feet apart and extending all the way across his five acres, the size of his first planting. In this case the rows were about five hundred feet long. Two beans only

Castor Beans. About Actual Size.
From these the castor oil of commerce is pressed.

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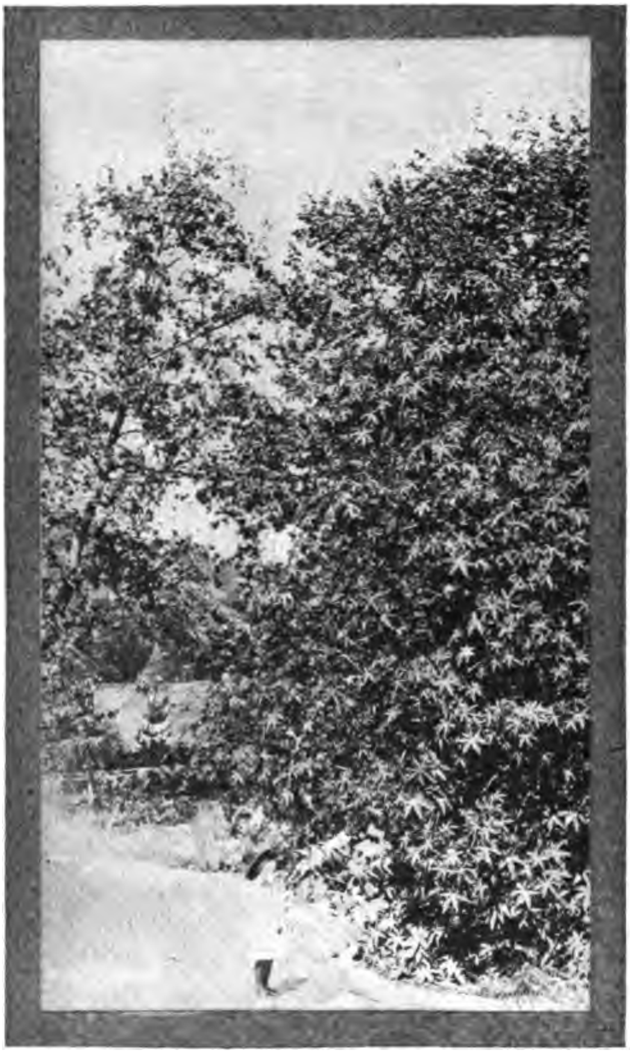

A Castor Bean "Tree" Thirty Feet High—at Right of Photograph.

were sown to the "hill," as these are practically sure growers, the seed being rarely if ever infertile. As the plants came up, they were thinned out so that only the sturdiest remained, one plant to each hill.

The first year the seed pods were clipped off, and, as often as possible, the buds were cut back before they had an opportunity to burst in bloom. This allowed all the strength to go to the plant, and the result was that by the end of the first season his five acres had the appearance of a young, heavily-trunked forest of some sort of tropical tree.

At the beginning of the blossom season the next spring, however, the trunks were fully settled into the hard, fibrous growth of the adult plant, and all their strength was allowed to go to blossom and seed. When the pods of the castor bean are ripe, they split open and the seeds fall to the ground, making, in the case of the wild plants, a tangle of growth by the second or third year which is comparable only to the jungles of mesquite which cover some of the lower parts of the California desert.

This cracking open of the pods and consequent waste of seeds, Brass had to guard against, and so he cut the first crop as soon as the pods turned from green to deep, purplish black, the sign that the seeds inside have changed from white to the peculiar mottled markings which denote full growth. The clusters of seed pods were then laid on a huge dirt floor, previously cleaned of all brush and grass and swept as clean of dust and sand as it could possibly be.

There they were allowed to lie in the sun until they cracked open and the seeds fell to the bottom of the piles. No animal or bird will eat these castor beans, or even pick at them, so they were perfectly safe for any length of time outdoors in dry weather. To insure the shelling out of all the beans, however, Brass went over the piles with a light flail, then cleaned off all the brushwood of the pods and stems and put the resultant piles of beans through a fanning mill of his own devising, ordinary fanning mills or "dusters" being too small to handle the beans success-

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fully. Brass had the patience to do his work well.

When the beans were sacked and weighed, all the small ones having been culled out in the winnowing process, Brass discovered that he had between four and five tons of as fine beans as could be produced anywhere in the world. For these he received five cents per pound, almost $100 per acre from his five acres.

The work done on the beans had been all his own, with the aid of one horse, and had been performed at spare times from caring for a large barley field which he owned. The beans were so much more profitable than the barley that the thrifty German the next season set out

CASTOR BEAN "TREE" TWO YEARS OLD, SHOWING SEED PODS ALMOST RIPE ENOUGH TO HARVEST.
The trunk is three inches in diameter, and the height of tree eight feet.

fifteen more acres to the oil-producing shrubs. From these he has consistently, during the eight or nine years since that first experiment, received an income averaging $100 per acre. At times of great yield, apparently when the castor bean producers of other parts of the world were unloading big stocks on the market, prices have gone down, but Mr.

SEED PODS AND BLOSSOMS OF CASTOR BEAN.
The blossoms appear below the seed pods on the stalk. These seed pods are more than half an inch, each, in diameter.

Brass has never received less than three cents per pound for his beans, and, during one or two years, the price went as high as six cents. The demand for the beans is always good, and Brass believes that a field of one hundred acres would be more profitable than 100 acres of alfalfa, one of the best-paying crops of Southern California. Alfalfa, oranges, or lemons, the three most famous products of the southwestern edge of the continent, require water for their growth, and much care, while practically all that needs to be done to the castor beans is the setting out, cultivation about once a year and the cutting off of the buds the first season.

Irrigation being negligible with this crop, it has been suggested that they would make very good products for parts of the desert where irrigation systems have not yet been installed. The plants

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are easily eradicated from the land when it is desired to turn it to other crops, or when water is brought in canals, as it has been on so many sections of what was arid southern California.

A first crop of castor beans has been suggested as a good thing for the farmers of the famous Salt River Valley in Arizona, while waiting for the completion of the system which is to give them abundant irrigation water. It appears equally suited for the districts of the Imperial Valley section, to which water has not yet been brought, but for which canals from the great Rio Colorado are now being dug as fast as they possibly can be.

SINGLE SPIKE OF CASTOR BEAN PODS, EIGHTEEN INCHES LONG.
The usual length is twelve inches or less.

In arid or semi-arid regions of the South, Mr. Brass believes his pet crop could be grown with profit, and says that from what he has read of the sand-hills of Tennessee and Georgia he believe the climate and soil conditions are admirably suited for the cultivation of the beans. Land values must, of course, be taken into consideration in the planting of castor beans, and in places where more valuable land demands more profitable production, they are out of the question.

But, to return to the handling of the crop of castor beans and the plants. After the threshing is over, the beans sacked and shipped away or stored, another crop soon appears on the bushes. The beans in this instance are smaller and not so full of oil as those of the first crop, and Mr. Brass believes it is best to cut them off before the seed begins to form. In fact, at this time, which is in September or thereabouts, all depending on the time of getting away of the first crop, this expert cuts back all the trees on the ground, leaving only a stump three or four inches high to show that the ground contains anything.

This he does for a two-fold reason: If allowed to continue their growth through the rainy season, the castor bean shrubs will become veritable trees, ten or fifteen feet high, and with branches badly interlocked across the five feet of space which separates the rows. This makes the gathering of the beans a hard process, requiring two men and step-ladders. The other of his reasons is that the further growth of the shrubs allows too much of

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the strength of the plant to go to the fiber of the tree and not enough to the bean itself. In fact, beans from trees more than two seasons old, show a material decrease in size and consequently do not contain anything like so much oil as the product from the younger shrubs.

In the spring following the cutting back of the castor bean bushes, the stumps put up green shoots, many of them to each stump. As soon as these have given signs of relative strength, the stumps are "suckered," much the same operation as that performed on corn in the East. That is to say, all the young shoots except one on each of the stumps are cut off. In some cases they will come up again, but if treated with a generous coating of salt, will usually die down permanently.

This process has to be gone through with each spring, but can be done rapidly by a man who knows how to go at the task, Mr. Brass taking entire care of his large field himself with the aid of one horse. The single shoot remaining, receiving all the strength from the two-year-old root, springs upward rapidly and is soon a respectable shrub, putting out dozens of blossom stalks, which are, in this case, allowed to come to maturity, instead of being cut off as in the first year's first growth.

The beans put out by these stalks are as large and as full of oil as those received the first year, and the bushes are lower, less branched, and on the whole, much easier to pick over. The process of cutting down of the whole plant and rearing of fresh shrubs from the old roots is gone through with each season, but Mr. Brass states that he believes it will give better results if the old stumps are grubbed out and fresh seed planted about every five or six years.

All over southern California, whereever there are dry washes or other strips of unusual ground, miniature forests of wild castor bean trees are to be found. Untrimmed, unharvested, and fed by the underground flow of these washes, these plants grow to immense size. One tree which the writer measured a little while ago was twenty-two feet in height and the trunk seven inches thick at the base. All such "trees" are heavily laden, but the beans are, as a rule, smaller than those which come from first year cuttings.

As has been said, the demand for them is large and it is surprising that some one has not entered extensively into the gathering of this wild crop in the Southwest. The poisonous character of the beans, however, is probably the greatest deterrent, or the ubiquitous small boy would long ago have added these to his financial resources, especially as they ripen during vacation time when he has plenty of time and liberty to gather them.

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THE LARGEST TOOL ROOM IN THE WORLD IN WHICH ARE BEING MANUFACTURED TOOLS FOR MAKING ONE MACHINE.

THE HAIR'S BREADTH

By MERRILL M. HUNTING

WE sometimes read of hair's breadth escapes, but when you stop to think of it, what is a hair's breadth? In other words, what is the diameter of a hair?

If you put this question to a toolmaker, he will probably reach up to the breast pocket of his apron and produce a little instrument that resembles a clamp. Then he will screw it down snugly upon a hair from your head and tell you it is seventeen ten thousandths of an inch in diameter. You will wonder how he can tell you so quickly and accurately, but the toolmaker is accustomed to working in ten thousandths of an inch, and the little instrument known to him as a micrometer caliper is indispensable to him in his work.

We look at our watches in the morning, go down to our place of business, open the safe, write letters upon a typewriter and make change from a cash register, but how many of us ever ponder upon the infinite care and precision with which each part, composing the different pieces of mechanism, is made?

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If we visit the factories where these various machines are made, we see men turning out parts with apparently little attention to their work, but if we look closely we will see that nearly every workman has a fixture of some kind in which he clamps the piece he is making before it goes through the particular machine process which it is his duty to give to it.

It is in the making of these fixtures that the little hair measuring instrument plays the important part, and where the ten thousandth part of an inch is a matter of almost hourly consideration.

When a piece of work is turned over to the toolmaker, he is usually given a limit of error within which he must keep, in all his measurements. For example—if a fixture is required for drilling several holes one-half inch apart, the workman may be allowed a variation of one thousandth of an inch in the distance between the holes. In some cases, however, measurements must be very exact and a variation of only a ten thousandth is allowed.

An example of close work is found in the making of gauges for the inspection of tools and finished parts. Watch for a moment this man seated before a rapidly revolving lathe, in which is swung a cylindrical piece of steel. He slowly draws a heavy ring moistened with a mixture of oil and emery dust backward and forward over the surface of the cylinder. Every few moments he will remove it from the machine and after wiping it carefully he holds it for a moment in a dish of cold water, then gauges it with his micrometer. He is making a standard plug gauge.

If he sees you are interested he will probably get you a similar plug and a ring which has a hole in it of the same diameter as the plug. As he holds them up for your inspection they shine in the sunlight like burnished silver.

Now carefully slip the plug inside the ring. You will have to push it in hard for it fits very snugly. You examine them a few moments and then the workman asks you to pull the two gauges apart. To your great surprise you find that you cannot do it, for the heat of your hand has so expanded the metal that it is impossible to draw the plug out of the ring until it has become cool. Even the combined strength of two men is not sufficient to draw the two gauges apart.

This expansion of the metal from variations in temperature is an important consideration in the making of tools, and it is for this reason that it was necessary to hold the plug in water a moment before measuring it.

Trying to Pull Plug and Ring Gauges Apart After Expanded from Heat of Hand.

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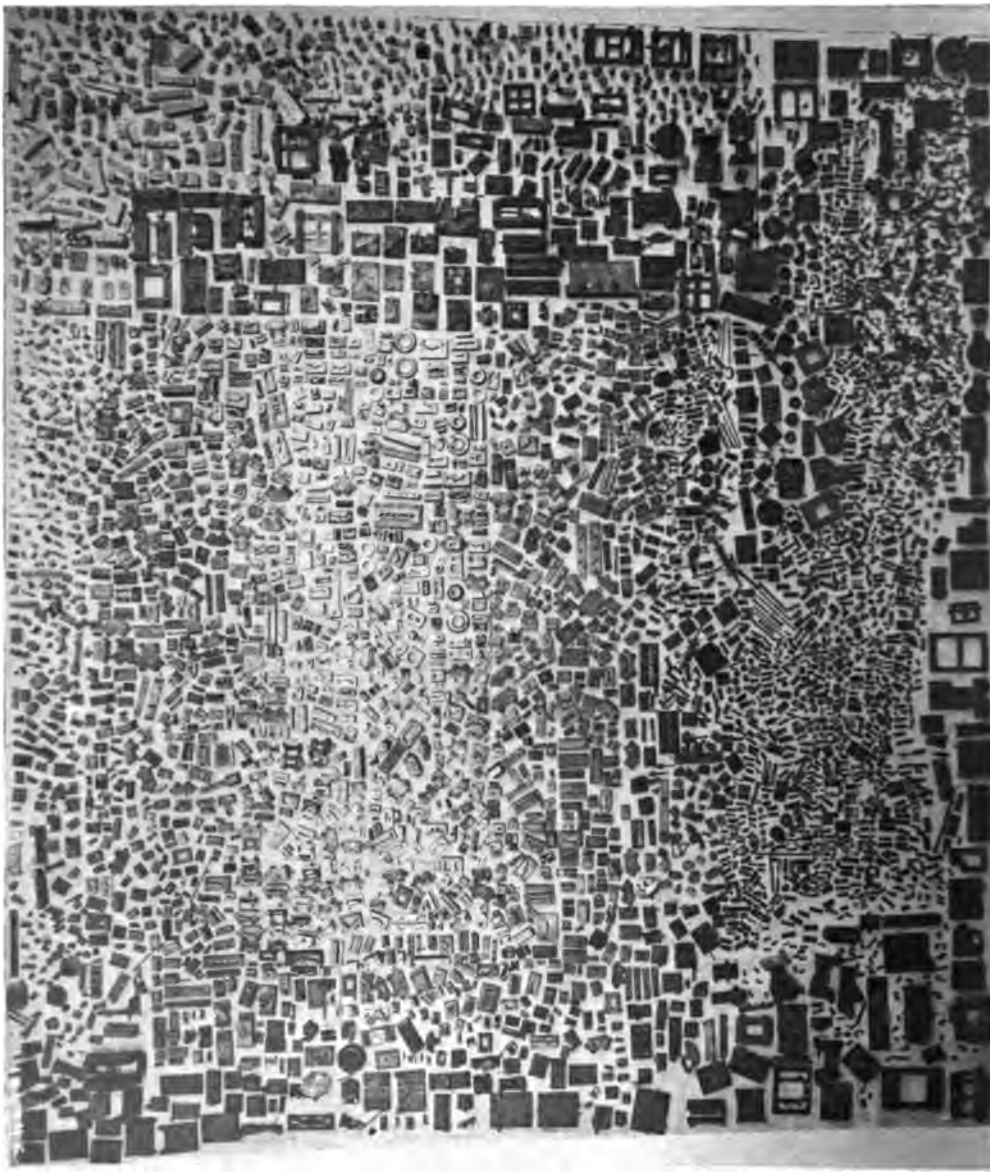


A BEWILDERING ARRAY OF TOOLS, NO TWO QUITE ALIKE, THAT ARE USED IN MAKING THE PARTS OF ONE MACHINE.

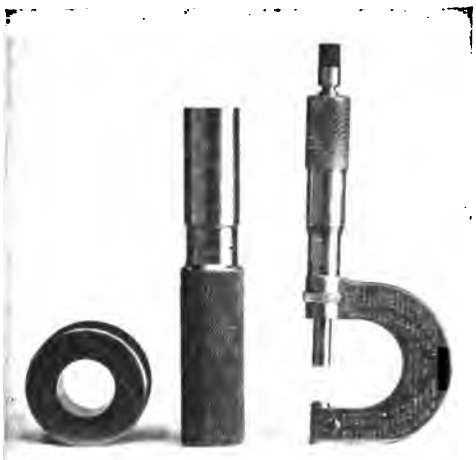
The plug acquires sufficient heat from the lapping process, as it is called, to increase its size materially, and if the maker were to depend upon his measurement of the plug while warm, he would continue the lapping until the finished plug, when cold, would be too small.

Among the closest pieces of work required of the toolmaker, is the making of dies for stamping out irregular shaped pieces from sheet metal, and forming them into the required shape.

Dies of this character are made in two parts. The upper or male die and the lower or female die. The female die is usually made first by laying out the shape of the piece to be punched upon the surface of a block of tool steel. Then this shape is worked out roughly by various machine processes and finished by hand with files of different shapes and sizes.

The male die is then made to conform to the shape of the female and fitted by extremely careful filing until the one will fit inside the other so closely that daylight is not visible between the two parts at any point.

When the pieces to be punched by the dies are small and of irregular shape, the fitting of the two dies to each other is extremely delicate work, for should an error be made the tool is useless and must be made over.



Ring Gauge, Plug Gauge, and Micrometer Caliper.

As an example of this, a large manufacturing firm had prepared dies in which castings from soft metal were to be made. They failed to take into consideration the expansion of the metal when hot, or the contraction of the casting when cold. As a result an error of several thousandths of an inch was made in the diameter of the finished casting.

Having no accurate way of measuring this expansion and contraction of the two metals, the making of the dies was more or less of an experiment. Several sets were made before one of the

DOOR OF VAULT, SHOWING HAND-FINISHING ON PARTS OF LOCK MECHANISM.

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MEASURING PLUG GAUGE WITH MICROMETER.

proper size was secured, and then satisfactory castings were produced only after discovering that the dies must be hot when the metal was poured into them.

Any variation in the temperature of either the dies or the metal made variations in the finished casting, and many hundreds of dollars were spent before apparatus capable of producing these results were secured.

As all dies for punching out work must be made hard before they can be used, a great many unavoidable errors occur in the hardening process. The action of fire and water used in hardening the die will distort it more or less in spite of all precautions.

The male die may come through the hardening process perfectly, but the female may be so distorted that the one will not fit the other at all. Either one or the other, and sometimes both, must be remade before the proper results can be secured from them.

Tools are often designed with a view to more rapid production of parts, which prove impracticable when put into actual use. For years a certain manufacturer had been putting a part through several machine processes to accurately form it, when it occurred to him that with certain special tools the work could all be done in one operation.

Expensive tools were made, inspected and found to be satisfactory. After being used a short time, however, it was found necessary to sharpen them, and they were sent to the grinding department. When they were again put into use they were found very inaccurate, the grinding process having so altered their shape that they could not be used. They were therefore abandoned and several hundred dollars charged up to experience.

The skill acquired by the toolmaker in taking accurate measurements with a common scale or rule is sometimes surprising. As a pastime several workmen will test their ability along this line. A punch mark is made upon the surface of a block of iron, then with a scale they will lay off a certain distance, say—one inch—and make another punch mark. This distance is then tested by a more delicate instrument and the results compared. Many experienced men can come within two or three thousandths of the exact distance.

Work requiring such careful measurements must of necessity be done slowly, consequently the making of large fix-

A DRILL JIG.

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tures, or "jigs" as they are called sometimes, often requires the work of one man for five or six weeks. Each part must be exactly located in its place in the finished fixture. Some pieces must be hardened to prevent wear, while others less exposed to damage from this cause may be left in their natural state. All must be finished as to present a neat appearance, and it is in the finishing that the toolmaker takes particular pride.

The body of a "jig" is usually finished bright, and often decorated with a design worked out by the use of emery cloth, or scraped with special tools in a handsome design.

The beautiful mottled effects of case hardened pieces, a screw head, or a pin here and there, tinted by heating until it slightly changes color, all add to the appearance of the finished fixture and put something of the artistic into the daily routine of the mechanic's work. A common example of this is seen on the combinations and lock mechanisms of large vaults. This decorating of tools, however, requires considerable time, and as time means money to the manufacturer, it is not often permitted unless the tools are for exhibition or manufactured for the market.

Although a highly skilled workman, the toolmaker is not particularly well paid, the average wage being from thirty to fifty cents per hour.

After becoming a skilled workman, however, he may by acquiring a knowledge of drawing, become a tool designer, when his salary will only be limited by his ability.

REMARKABLE SIGNALLING DEVICE

By C. H. CLAUDY

IF a man puts in your hands a mirror, which shows you your face upside down, instead of inverted as to right and left, you immediately begin to wonder, and when, in an endeavor to solve the mystery, you turn and twist it in your hands, and find that at no angle at which you can hold it can you make it stop reflecting your face, you are going to be very much surprised indeed.

Such a mirror is the heart of a new signalling device, invented and perfected in Germany, and now introduced in this country. This instrument is called a triple mirror, because it has three reflecting surfaces, although in looking at it, the three appear as one crossed with radial straight lines. At no matter what angle incident light rays strike this mirror, they are reflected back along their incident path. The variation is so small that in a mile it is less than a foot.

This triple mirror is made of one piece of glass, in the form of a specially shaped prism. This prism is, in shape, a pyramid of three sides, the edges of which make right angles to each other at the point, and the base of which is at an angle of forty-five degrees with the sides. In other words three equilateral right angle triangles are made into a pyramid. These triangles are planes of the prism in practice, and in use the prism is inverted so that the point is inwards and the reflection passes through the plane side, or base, of the pyramid before it strikes the sides. Now as the three sides are all at right angles to each other, it makes no difference at what angle a ray of light strikes one—it is necessarily reflected from that one to another, and as two reflecting surfaces at right angles to each other bend a light ray back upon itself, back the light ray comes. This mirror is simply an adaptation of a well known geometrical principle, only, as the instrument must concern itself with three dimensions instead of the two of diagrammatics, a third reflecting surface is added.

Now for the practical use to which this device may be put. In the first place, the

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mirror is not very large,—only a few inches across, nor is it weighty, and it may be carried easily in the hand, strung to a flag pole, tied to a saddle or disposed in any way for use, either travelling or stationary. An incident ray of light hitting this mirror is returned absolutely along the path through which it came, and is not visible to any one outside this path. Let us suppose a scout in the day time, in time of war, who wishes to communicate with a home station. He could not carry an electric light powerful enough to send a beam of light several miles, but he can easily carry the mirror. Headquarters throws a search light beam upon him and his mirror. That beam comes straight back home again. To signal, the scout has merely to cap and uncap the mirror with his hand or his hat, to send back dots and dashes of light, which are easily read through a small telescope, even in bright sunlight. And during the day, neither the sending nor the receiving ray are visible to any one not directly in the path of either.

Facing the Camera.
Note camera lens reflected in mirror, and operator's hand near lens.

To send such messages, headquarters caps and uncaps its search light, by a little device shown in one of the pictures. The method is more portable than a heliograph, swifter to set up and operate than a field buzzer or wireless outfit, and less conspicuous than a wigwag.

But its use, of course, is not limited to day. In the night the incident search light beam is visible, of course,—the returning beam not at all so, under any circumstances. Suppose a vessel coming into harbor. If she is equipped with this mirror, a search light beam might tip her mast—and the mirror — without making her visible, yet a message could be sent from ship to shore, without knowledge of any one not directly behind the sending search light. Two ships, so equipped, could talk with each other across a whole fleet, and no other ship could read the message, which would not be the case with wireless or any known method of signalling. Two crossing search light beams would be seen, but the return rays, with which the signalling is done, would be so feeble as to make no trace upon dust or smoke in the air, and, saving the almost unthinkable contingency that a third party was directly in line with the first two ships, the returning beam would take its message straight home and to no other place.

Of course, any reflecting surface would do, were it always possible to insure that the plane of the reflecting surface was exactly perpendicular to the plane of the sending beam. But that is impossible. With the triple mirror, a ship may pitch and toss upon the waves, a horseman may gallop up and down, or a man may climb a tree with the mirror on his back and at no matter what angle the incident beam strikes, it comes directly back to the sending point.

The writer in making the pictures which illustrate this article had an opportunity to test the apparatus. A triple mirror had been hung on a flag pole two miles away. The flag pole was hardly to be seen with the naked eye, the mirror not at all. A good glass showed it as a speck. When the light was turned on

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from the search light, however, and the mirror was found in the small Zeiss prism glass attached to the lamp, the mirror appeared as a blindingly white speck, which appeared and disappeared as the light was cut off and turned on. Standing behind the search light with both feet planted firmly to allow of a steady view, the writer focused this bright speck in a hand glass. Without moving his body he could lose the speck completely by swaying from side to side on his feet, showing that the returning beam was but a foot or so wide and with a sharply defined edge.

The searchlight, so called, designed to be used with this apparatus, is a model of lightness and simplicity. It is an oxy-hydrogen principle, the elements being oxygen and acetylene gas in tanks. The gases are properly mixed in a nozzle and projected, when ignited, upon a small button of magnesia, which heats to an intense white heat. This faces a parabolic reflecting mirror of the highest possible optical efficiency, which projects the beam in a straight line and with very little divergence. The signalling from this lamp is done with a small cut-off, which drops a screen in front of the white-hot button, this preventing the light from reaching the mirror.

The illustrations show this construction and also the lightness and simplicity of the apparatus.

The set of pictures showing the mirror in the hands of an operator are extremely interesting. Each one shows the mirror at a different angle with the camera, and each one shows the black front of the camera, the camera lens, and the white hand of the camera operator placed across the front for this purpose.

It is of course understood that the entire success of this whole device depends upon having the sides of the prism absolutely plane and perfect and absolutely at right angles and forty-five-degree angles, in the planes and on the edges. If the slightest variation occurs, the angle of reflection will not be along the path of the incident ray but according to the ancient law that the angle of reflection is equal and opposite to the angle of incidence, which would result in deflecting the ray a greater or less degree from the path of the original ray. Something of the accuracy of methods of optical work can be gathered from what has been said of the degree of divergence of the ray, when it can be lost from behind the ray's source by swaying on one's feet! It was interesting to note that it was with difficulty that the photographs showing the mirror in use could be made, for this reason: The lens of the camera had to be focused on the mirror itself. The light rays from the actual reflecting surfaces, however, showing the lens and operator's hand, came from twice the distance that the rest of the picture did. Suppose the camera was ten feet from the man holding the mirror. Light reflected from the man, the mirror case, etc., came ten feet to the camera lens and that instrument was focused accordingly. But the light which formed the image of the lens and the hand, reflected in the mirror, came twenty feet, since it had to go and come the distance

THE SENDING AND RECEIVING TRIPLE MIRROR OUTFIT.
Triple mirror in operator's hand.

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separating subject and operator. Consequently the lens on the camera had to be stopped down to a very small aperture to accomplish the necessary depth of focus. It was found quite impossible to make a clear picture of both mirror and its reflection when the mirror and the camera were close together, as was tried in an endeavor to get a sharp and large picture of the mirror.

THE WHITE-HOT MAGNESIA BUTTON.
Parabolic reflector not yet in place.

The reader may be inclined to wonder why the reflected beam of the search light is not visible, on a dark night, as the original search light beam is visible, by reflection from dust particles in the air. The reason is twofold. In the first place, the larger the area of any beam of light striking through the atmosphere, the less its original brightness need be in order that it make itself visible on dust in the air. Thus, a ship, brilliantly illuminated, throws a radiance on the air above it, even if the actual lights themselves be hidden from view. None of the lights, individually, are very bright, but the collection is sufficient in area to illuminate the dust above. Cut down the illumination to one or two lights, and they are too weak to send forth enough light to stand reflection.

Now the reflected beam of the search light, from the triple mirror, is very much less in area than the original sending beam. It is also very much less brilliant, because no reflected light has the original potency of its source, due to loss by absorption, refraction, polarization and scattering.

In this are the two reasons why the return beam is not seen. The area is so much smaller that the light would have to be much brighter than the original beam, in order to send enough light to be reflected from dust particles in the air—as a matter of fact the reflected beam is much weaker in intensity. If the observer, on a ship two miles away sees a lantern lit upon the shore, he does not see any rays from the lantern in the air—merely the direct rays of the lantern itself. But that lantern would be visible to any one. The reflected beam from the triple mirror is a lantern lit by the observer himself, with his search light, and what he sees in return is merely a bright point of light. But no one else, not in the same line as the observer can see that bright point of light. Doubtless, a mirror would be useless, could the observer light an electric light on shore, and signal with it, and with the assurance that no one but himself could see it, but that he cannot do. He must control the light himself, which he can do only by first sending it, and then receiving it, and receiving it in such a condition, as to area and brightness, that no one but himself can see it. This is exactly what the triple mirror does, and because it does it, it forms a means of night signalling which, as to the context of the message, if not the fact of a message being sent, is absolutely secret. In fact, unless the existence of the triple mirror be known to interested parties, a message might be sent with no knowledge of its being sent, since all that would appear to the observers would be what appeared to them as a stationary search light beam through the air.

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THE OXY-HYDROGEN BLOW-PIPE DEMONSTRATING ITS ABILITY TO CUT AN ARMOR PLATE SEVEN INCHES THICK.

NEW PROCESS OF CUTTING IRON AND STEEL

By J. B. VAN BRUSSEL

Belgian Correspondent TECHNICAL WORLD MAGAZINE

IT is well known that iron burns easily and rapidly in an atmosphere of oxygen gas. The experiment is familiar in every course in physics and chemistry. The same phenomenon occurs when a jet of oxygen is directed upon iron heated to a bright red, that is to say, the metal burns and the heat evolved fuses the oxide. A process for cutting metal plates by oxygen is based on these phenomena; it can readily be seen that it is possible to divide a piece of metal by means of an oxygen jet, but it is not easy in practice to attain a rēgular and clean cut.

At first, use was made of an oxy-hydrogen blow pipe to bring a certain portion of the work to a bright red heat. Then the flow of hydrogen was cut off and the current of pure oxygen was increased. A good combustion was produced, but it did not proceed very long. The resultant iron oxide not being hot enough, lacked fluidity; it was with difficulty removed, became mixed with the partially melted iron, and thus obstructed the close contact of the metal with the oxygen; the combustion stopped and it was necessary to bring the blow-pipe into play again. The manipulator, even after long practice, could obtain only an irregular cut, dirty, and with edges incrusted with closely-adhering oxide.

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One of the engineers of the Societé l'Oxhydrique, Brussels, Belgium, therefore devised a double apparatus which entirely remedies these difficulties. This apparatus consists of two blow-pipes in one piece, which travel along the section to be cut. The first is an ordinary oxy-hydrogen blow-pipe, which delivers an ignited jet of mixed oxygen and hydrogen, and so heats the metal to a bright red; the second directs a fine jet of pure oxygen upon the heated spot spread into the mass and the oxidized portion is removed by the pressure of the oxygen; the section is cleaner than a saw-cut and its width never exceeds one-sixth of an inch. The speed of travel of the double blow-pipe is about eight inches a minute; in other words, the operation is quite rapid and comparable to hot sawing.

The double blow-pipe which is easily handled and furthermore may be guided by any sort of mechanical device, is

THE OLD PNEUMATIC PROCESS OF CUTTING ARMOR PLATE.
A very slow method as compared with the oxy-hydrogen process.

under a pressure varying with the thickness of the metal.

The action of the two blow-pipes is continuous; the first prepares the way for the second. In fact, the metal after having been heated by the oxy-hydrogen flame is rapidly cut or rather burned through by the oxygen, the temperature being raised to 1,300 or 1,400 degrees F. by the combustion of the metal. The metal is not melted, and the adjoining parts remain unaltered, as the action proceeds too rapidly for the heat to available for cutting not only thick plates, but also, and with equal ease, tubes, beams, shafts, and all sorts of rolled sections. The cutting may be made to follow any line, executing all sorts of curves and profiles; further, it is not necessarily normal to the surface, the cut being easily made on a level. It is evident further that the quality or the mechanical properties of the metal do not in any way modify the process; whether it be hard or soft, tempered or annealed, chrome or Harveyized, the steel burns

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CUTTING A HOLLOW SHAFT OF THREE-INCH THICKNESS.

just as fast. The problem of cutting armor plates is thus fully solved.

Armor plate can be cut in from one-tenth to one-twentieth of the time required for mechanical cutting, and the sharply localized heating probably causes less strain than punching and shearing develop. If oxygen costs two cents and hydrogen two-thirds of a cent per cubic foot, the cost of cutting an iron plate four-fifths of an inch thick is about seven and one-fourth cents per running foot, thus about half the cost of mechanical cutting.

In illustration of the rapidity which above all characterizes oxy-hydrogen cutting some examples may be adduced: An armor plate 6.3 inches thick was cut to a length of three feet four inches in ten minutes. A cut of similar length in a plate three-fifths of an inch thick took less than five minutes, and the cost of the operation did not exceed thirty cents.

Another very striking example was furnished at the station of the Metropolitan Railway at the Place d'Italie in Paris. It was necessary to cut away an iron staircase twenty feet high whose width impeded the traffic. It was cut down to a width of three feet four inches in four hours' time,—certainly remarkably quick work.

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CONQUERING THE FIR STUMP

By BRADFORD K. DANIELS

SINCE the discovery of that region constituting part of the present State of Washington, the fir stump has blocked the progress of civilization west of the Cascades, from Oregon to British Columbia. Science has found ways to span the state's rivers, tunnel its mountains, and irrigate its deserts, but until recently it has been unable to cope with the fir stump. Bulky, firm rooted in the earth, and so saturated with pitch that it will not decay, it has defied everything but dynamite, and that costs about three dollars a stump, with an equal amount to cover the expenses of the donkey-engine necessary to remove the roots, when the main body of the stump has been shattered. Clearly such a costly process cannot be used for agricultural purposes in a heavily timbered country.

And such has proved the case. The lumberman, in his scramble to supply the world with fir lumber, has moved through the great Washington forests with portable mills and donkey-engines, converting the vast evergreen stretches into an abomination of desolation. When he has departed fire is sure to follow, leaving only a wilderness of blackened stumps, to remove which costs all the way from $150 to $200 an acre. No wonder that logged-off land sells for a song. Under these conditions it seems a bad bargain at any price.

With a chain of cities running right through the timber belt from Portland to British Columbia, the food question west of the Cascades is rapidly becoming a serious one, and as these cities grow by leaps and bounds—Tacoma has now a population of 100,000 and Seattle of 250,000—the need of adjacent farming land is more and more urgent. And indeed the land is there, within a few minutes' ride of either of these centers; but the fir stump stands guard and warns the farmer off.

One man, who had pondered long upon the stump problem and proved the ordinary stump pullers used upon the oak stumps of Ohio as useless as tweezers, thought he had solved it by applying a chemical that brought about hasty decomposition. The part of the stump above the ground did decay, but the roots remained, lying in wait for the plow like a lot of subterranean dragons. In short, the farmers, except the few in the bottom lands, gave up the fight and took land in the dry country east of the Cascades, leaving the grim stumps in undisputed possession. Here and

FIRE BURROWING INTO THE ROOTS OF A MONSTER FIR.

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THE TWELVE SECTIONS OF RUBBER HOSE THROUGH WHICH AIR FANS THE BLAZE AT THE BASE OF THE STUMPS.

there a rich man amuses himself by clearing a few acres, but for the most part the homesteads taken up are still in the wild state, the owners working in the saw mills and logging camps.

Such was the situation, when three years ago an enterprising farmer conceived the idea of burning out the stumps by forced draft. After many experiments, he finally got a four horse-power donkey-engine, attached a six-inch American blower, and over this he fitted a tin case with twelve tubes leading from it. To these he attached pieces of garden hose, and to the ends iron pipe. Then he bored a hole in a stump, and dropping in a live coal, inserted a pipe and started the engine. In a few moments the hole was aflame, and soon a dozen stumps were blazing, although it was the wet season and the monsters were sodden with water.

This was the beginning. The inventor soon found that his garden hose was not large enough to burn out a big stump with reasonable rapidity, so he inserted inch and a half rubber hose. This worked better, but still the process consumed too much time; besides, the hose buckled and cracked. Then he resorted to wire center two-inch hose and two-inch iron pipe, and replaced the six-inch blower with a twelve-inch one.

The illustrations show the invention in operation. The engine is placed upon runners and warped into position by means of a wire cable attached to a stump. A two-inch ship auger is used for boring the first hole in the stump, which is placed at the level of the ground and bored in for a couple of feet. As soon as the fire has eaten a cavity a foot or so in diameter, several holes are bored into it with an inch auger from different sides of the stump, and these, acting as chimneys, are soon belching fire. Then the small timber lying about the ground is junked up and fed into the flaming cavity, so that when the stump is consumed the ground is clean.

If the Washington lumbermen would cut their trees a couple of feet above the ground, the burning problem would be greatly simplified; but in their haste they saw them off at a height of six or eight feet, partly because the diameter is less here, and partly because the lower part

THE CAVITY SHOWING THROUGH THE STUMP WAS BURNED OUT IN THREE HOURS.
This stump is five feet in diameter.

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of the trunk contains too much pitch for first-class lumber. The huge chunks of wood remaining have to be consumed along with the roots of the stump, thus adding considerably to the cost of clearing the land. When the fire has cut a stump completely off, the top settles down into the cavity, and the current of air is applied until it is consumed and the roots have been burned deep enough for the plow to pass over them.

By using gasoline for firing purposes, a steady pressure is obtained and the engineer is free to tend the burning stumps. With gasoline for fuel, two men burn twelve stumps a day with the present patent, and they could readily attend to twice the number if twenty-four pipes, the number contemplated, were used instead of twelve.

With the old method of dynamite and donkey-engine, the destruction of twenty-four stumps ranging from five to eight feet in diameter would cost about $125. If consumed by the new process, the cost should not exceed ten dollars. Even with the present arrangement of twelve pipes, the cost has been reduced about three-quarters.

Besides the reduction in the cost of clearing the land, the soil is left in much better condition by the new method. When a stump is dynamited, a hole six feet deep is excavated and the poor subsoil thus brought to the surface. Not only must these holes be filled in at a considerable additional expense, but it requires several years of fertilizing and cultivation to restore the necessary humus to the soil.

"If it were done when 'tis done" by the dynamiting process, it would not be so bad; but so much earth adheres to the roots when they are dragged out by the stump puller that often they will not burn when piled together. One man had an exceptionally bitter experience in this way. Never suspecting that fire would not consume them, he spent thousands of dollars dynamiting stumps and dragging them together into huge piles, only to find them so coated with clay that they would not burn at all. The cost of pulling them apart and cleaning them equalled about one-half of the original outlay.

So, on the whole, it would seem that the ingenuity of the American has at last triumphed over the most doughty enemy to civilization in the Pacific Northwest, the fir stump. If it has, hundreds of thousands of acres will be added to the cultivated land of Washington State, with a corresponding increase in the farming population and farm products about Puget Sound.

Prayer

God answers sharp and sudden on some prayers,
And thrusts the thing we have prayed for in our face,
A gauntlet with a gift in 't.

—Browning.

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BEGINNING THE OPERATION—STARTING A MINE.

PHOSPHATE MINES OF FLORIDA

By M. E. BROWN

A DISCOVERY of phosphate in Volusia County, Florida, has called forth a new discussion on one of the leading industries of that state. Few people know that Florida produces more phosphate than all of the other states of the Union put together, and the product found in Florida yields sixty-five per cent bone phosphate, whereas that of other states falls much lower, and Florida's best, reaches much higher than sixty-five per cent.

As to the extent of the deposits, it is known that at least twelve counties contain mines open and in actual use, while new findings are made continually. Mr. D. D. Rogers, one of the leading prospectors of that state, has tested sand along many sections of the coast of Florida, and has found phosphate deposits each time. The sediment from the river drainage proves that nearly all of Florida has the phosphate to a greater or less extent.

Within the last few days, a land owner near Lake Helen, Volusia County, Florida, has discovered deposits in his 18,000 acre farm. He has subjected the findings to experts for examination, and if the deposit proves as valuable as that of other counties, his farm is easily worth a million; and his pebble phosphate, not the most valuable.

There are two varieties of phosphate, the hard, which is mined in great chunks, like those of an ore deposit, and the pebble which is in grains, more or less the size of a grain of wheat. The first is double the value of the second. The mines from Hernando County to Taylor contain the hard phosphate, and

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THE SUBSTANCE IS TORN FROM THE EARTH IN HUGE, SOLID CHUNKS.

A GENERAL VIEW OF THE FIELD.

THE BLOCKS OF THE PRODUCT BEGINNING TO TAKE FORM.

VARIOUS ASPECTS OF MINING PHOSPHATE.

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the new mines near Lake Helen contain the pebble, like that found in Hillsboro, Polk, Manatee and De Soto.

A good prospector is able to tell just how much land holds phosphate and the amount that can be mined. Sometimes the mass, for it is not found in veins or strata, lies near the surface and runs only a few feet deep; sometimes the shaft must be lowered fifty feet to obtain all of the product. There may be only a knob projection at the surface, and the deposit spread out in wide V expanse deeper down, or this may be reversed. Sometimes it is found in one-sixteenth of an acre only, or it may spread over a farm of 160 acres. One farm of 160 acres had a mine which produced 53,000 tons, and required a $40,000 plant to mine it. Since the phosphate netted $6 per ton—it was hard phosphate—still, the profit was enormous. A mine which has such a plant yields 50 to 100 tons per day and may last three months, or may last many months. The pebble nets about $3 per ton, while the cost of mining either is about $1.75 per ton. It is prepared for actual use as fertilizer by grinding it to a powder and drying out the moisture.

The wild craze which arose when these mines were first discovered in 1890, has subsided, and the work of mining has settled into a steady paying business. Only on the discovery of a new deposit does the excitement rise again.

These mines are owned principally by men of the United States, though the French and English have a hand in the business also. Although the capital which works the mines comes largely from other states, at the same time, the labor employed is great and the money expended for labor is distributed over the state of Florida. Some mines employ one hundred men, some several hundred. It is safe to say that not less than 25,000 men are employed in the phosphate mines of Florida.

Most of the capital which accrues from the sale of phosphate, remains in the state. The hard phosphate is shipped across the ocean and the pebble is shipped along the east coast of the United States.

If we count the men employed in prospecting for the mines, the capitalists who purchase lands, the laborers who work the mines, and those engaged in the commercial exchange, we find that this business of phosphate mining in Florida, ranks well among the profitable industries of the United States, and has a greater importance than is realized.

Sparkling and Bright

Sparkling and bright in liquid light
Does the wine our goblets gleam in;
With hues as red as the rosy bed
Which a bee would choose to dream in.

—C. F. Hoffman.

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UNDERGROUND DEPARTMENT STORES

By HUGH C. WEIR

UNDERGROUND department stores are heralding their attractions in fat-lettered type. In the campaign of the below-the-earth bargain counter, Philadelphia has taken a sudden and pronounced lead.

The recent opening of the eastern section of the Market Street subway gave the public the largest underground railway platform in the world, nearly a regulation block in length and rapidly taking rank as one of the city's busiest squares—forty feet below the pavement.

Above the ground at this point are located three of the largest department stores of the state, in fact representing the greatest collection of retail merchandise on the globe. When the scope of the subway station was appreciated, the startling basement possibilities of the location were made sharply apparent. The station was built to accommodate fifty thousand passengers without crowding—a fair-sized city. Separated from this stream of traffic by a space of but two or three feet were the cellars of the mammoth stores, embracing a floor space of 150,000 square feet, hitherto used only for storage purposes or for "notions." Why not carry arched doorways through to the subway, extend plate glass cases along the barren stretch of granite walls, and take full advantage of this startling

WINDOW ADVERTISING DISPLAY IN THE UNDERGROUND SHOP. WELL-LIGHTED, IS FULLY AS EFFECTIVE AS IF ON THE STREET LEVEL ABOVE.

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underground trade possibility which chance seemed to have provided?

So attractive did the idea appear that an army of workmen from the department stores kept pace with the subway builders and when the station was formally opened to the public, it was easily possible for the shopper to travel a distance of from three to five miles, and stock a wardrobe and even a house without once ascending above ground!

The dusty, barren basements had been transformed into a dazzling sea of merchandise. Hundreds of electric bulbs, strung from ceiling and walls, illuminated the scene as brightly as the noonday sun above the pavement. The shopper might have stepped in from the din of the street, instead of being directly below that din.

To develop the advantages of the subway to the greatest extent, a co-operative union was necessary between the various stores bordering on the station. Avenues of communication were required not only between the buildings, but over the subway tracks. A remarkable trade agreement was ratified, whereby all of the firms pledged themselves to contribute equally to the bargain-campaign under the earth.

This agreement was extended to the railroad company, so as to permit a customer to visit the station without being obliged to purchase a subway ticket. To accomplish this, a high iron fence was built at the edge of the train platforms and the overhead passageway or bridge of the department stores was carried above the rails.

ON ONE SIDE OF THE CORRIDOR. THE ATTRACTIVE NEW GOWNS: ON THE OTHER. THE ROAR OF THE SUBWAY TRAINS.

Between the stores on both sides of the station, cement passageways or tunnels were constructed, with the red-lettered sign of the rival firm suspended plainly at either end. A score of steps thus would take the hawk-eyed bargain-hunter from the Smith counters to those of Jones, without the necessity of ascending to the street at any point of the way.

At the intersection of Eighth and

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Market streets—the trading center of the city—immediately above the subway, occurs perhaps the most dangerous congestion of traffic in Philadelphia. By means of the underground passages, thousands of shoppers are enabled to make their way in security under the seething jam of Eighth Street, while the subway station itself opens a similar route under Market Street. It is estimated by the police that the plan will avoid hours of business delay and scores of serious accidents, while the network of underground corridors has already transferred fifty per cent of the sales of the department stores below the pavement.

THE EXIT TO STREET FROM THE SUBWAY IS ALSO THE ENTRANCE TO STORE.

On either side of the station, a long series of show windows extends for a distance of more than one hundred feet, over 2,500 square feet of space being devoted to display purposes. Indeed, the subway virtually affords the stores a second front, the art of the window dresser being exerted as effectively in the electric-lighted space below ground as in the busy swirl above ground.

The station is fireproof, or as nearly so as modern genius can make it. It is constructed throughout of reinforced concrete and steel, and the builders assert that a serious fire is literally impossible.

The Rapid Transit Company, the corporation operating the Philadelphia subway, has proffited materially by the ventilation evils experienced at New York. A committee of sanitary experts has been constantly employed in the supervision of the ventilating feature, and the problem has been approached from two angles. A system of ventilation tubes has been installed throughout the length of the road, and to guard against possible damage to these, a series of high pressure electric fans has been erected, which if necessary, can sweep the entire subway with a constant current of fresh air.

The construction of the line has covered a period of five years and a half and is a thorough success.

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DREDGING THE CHAGRES RIVER.
Marsh lands are being drained and reclaimed.

TREASURES IN PANAMA

By JOHN W. HALL

THERE is much decided misinformation as to the physical and geological formation of the territory in the Republic of Panama. The more or less prevalent idea is that on the whole it is an exceedingly low and swampy country, and that idea is erroneous. There are large tracts of marsh lands along the canal route and in the interior, yet there are large areas of high, hilly and mountainous lands. The natural resources of the country are great, and investigations indicate that those resources are largely diversified.

The United States possesses valuable deposits of gold, silver and copper as shown by analyses made of ores taken from the famous Culebra Cut. Three lots of samples of ores were sent from government cuttings to H. C. Demming, consulting state mineralogist of Pennsylvania, and he found that each lot revealed metals in paying quantities.

Following the lead of the government in creating the Republic of Panama, American enterprise is reaching out for the rich deposits of the little country and are fast opening up its fertile acres to practical usefulness. Public roads after the American type are being constructed and marsh lands are being reclaimed

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under the most improved methods. Not only are Americans operating along the canal zone but they are penetrating the unexplored regions of the Republic.

Under semi-official supervision a party headed by Dr. Frank Von Teuber has gone to Panama for the purpose of exploration. The exploration party is operating entirely on private capital but is semi-official in that it will supply to the Government of the United States, and of Panama, maps of the unexplored portions of Eastern Panama. All geological, biological and ornithological specimens collected on the expedition will be turned over to the Smithsonian Institution at Washington, and the Museum of Natural History of New York city.

TRACK-SHIFTING BY HAND IN THE BAS OBISPO CUT.

The primary object of these explorers is anthracite coal and precious metals. The geological formation of the eastern part of the Isthmus is such as to lead to the belief that in that area there are large deposits of coal which are well worth the mining.

This party of explorers will attempt to reach the boundary line of Colombia and, if successful, the information derived from the trip would be of vast benefit to the Panama government in case of war with Colombia. With this benefit in view President Amador, of Panama, has agreed to send relief parties in search of the explorers should they fail to return within reasonable time of expectation.

Dr. Von Teuber is no novice in the tropics. He has served as surgeon in one of the American hospitals on the Isthmus; he also acted as official photographer to the Panama Canal Commission. Some two years ago he went about one hundred and fifty miles into the eastern part of the Island, and that was nearly one-half the distance which is now being undertaken by his party.

On his previous expedition Dr. Von

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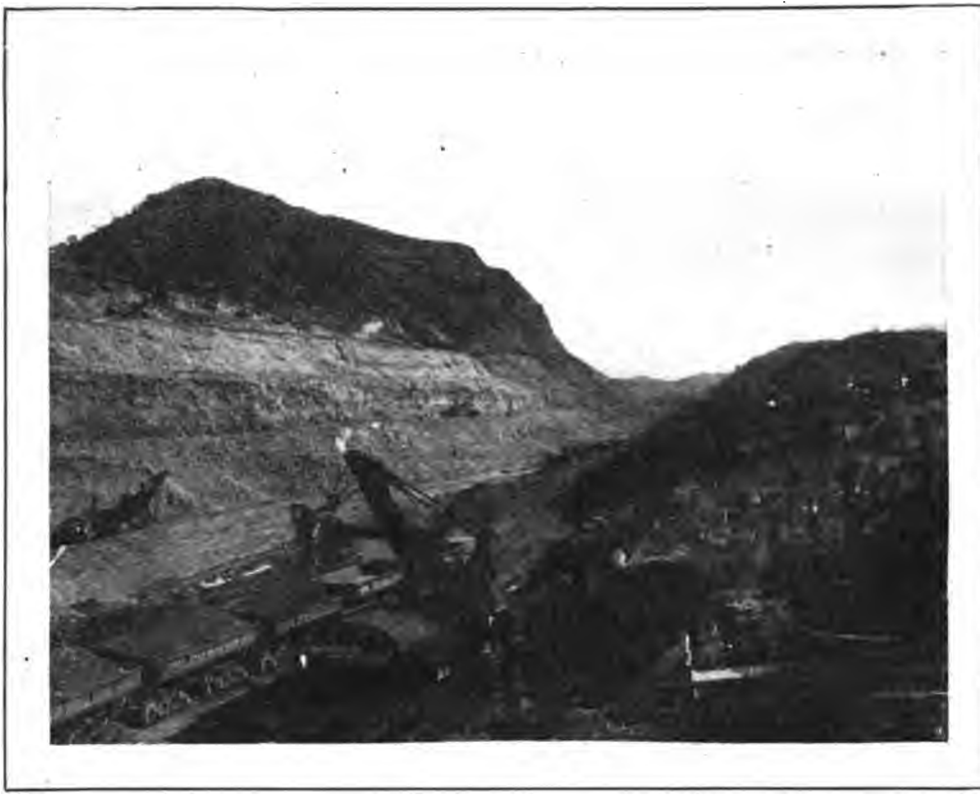

THE FAMOUS CULEBRA CUT, PANAMA.
Gold, silver, and copper ore have been found here in paying quantities.

Teuber was taken prisoner by the Indians on the Rio di Avalo River and then saw that they used as ballast on their boats a superior grade of anthracite coal. Acting on the information thus obtained, concessions for the mining of anthracite coal and numerous metals were obtained from the government of Panama.

The present expedition has for its chief object the determination of the value of the concessions obtained, and to make preliminary arrangements for operation. If the mining of coal on a commercial basis is plausible, the problem of supplying coal for use on the canal will be solved.

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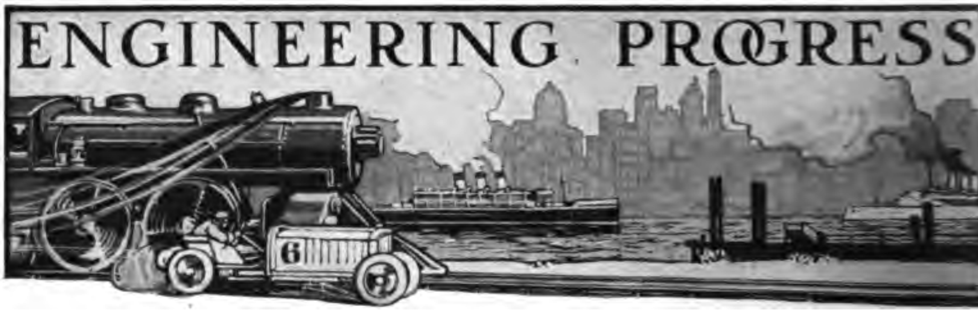

NEW AERIAL FERRY

RECENTLY at Marseilles, France, a new electrically operated aerial ferry was constructed. Similar aerial ferries or transporting bridges have been constructed in the United States, at Balboa, Spain, and at Rouen, Rochefory, and Mantis, France.

The traveling car which moves between the two landings Fort St. Nicholas on the southern side of the Port Vieux and Fort St. Jean, on the northern side, is supported by cables from a traveling trolley running on rails on the cantilever bridge. This trolley supports a car or platform. This car is used for transporting passengers, freight and vehicles between the two landings.

Electric power is utilized for moving the car. The ends of the cantilever bridge are anchored by means of vertical cables at each of the landings, and observation buildings are provided on the cantilever beyond the supporting tower, while a series of winding steps are arranged on each tower so that persons may mount to the level of the bridge and cross on two walks from ten to twelve feet in width.

ELECTRIC AERIAL FERRY AT MARSEILLES, FRANCE.

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FARM TRACTOR THAT DOES THE WORK OF SIX HORSES.

The charges for crossing on this electrically aerial ferry is 5 centimes or about 1 cent for a foot passenger, the same for a sheep, lamp, or goat, and 10 centimes or 2 cents for a horse, mule or cow, while the vehicles are charged for at the rate of 50 centimes, or 10 cents for an automobile, and from 5 centimes or 1 cent to 25 centimes or 5 cents for other vehicles, according to the weight, merchandise being charged for also in proportion to the weight.

This aerial electric ferry has been in operation now for some time and is said to haye given excellent satisfaction, covering the distance with considerable speed and without interfering with the traffic of the merchant vessels in the slightest degree.

AUTO TRACTOR SAVES HORSES

AGAIN the commercial automobile has come to the aid of the farmer, a new gasoline tractor capable of doing the work of six horses and costing but $1,000 having been put in the fields in southern California. It is particularly a one-man machine in that it can be driven from the seat of an ordinary wheel plow or harrow, this being one of the special features.

The front wheels are made of traction wheels, also the steering wheels. In the rear are smaller plain wheels, with flanges to hold against side slipping, used simply as trailers to which the plow cultivator, harrow or wagon, are hitched.

The power plant is built on a stiff steel frame and is composed of a two-cylinder opposed engine of standard make rated at twenty-four horse-power. The transmission is wholly by gears of large size and face. The intermediate shaft is so arranged that the main drive pinions can be removed and rearranged in a few minutes for higher speed road work. The wheels are of new design and run loose on the axle on frictionless roller bearings used throughout the machine. The main axle is pivoted to a sub-frame which extends to the rear wheel. Its purpose is to act as steering member and to receive the torsion of the driving effort.

The steering is done by a steel cable wrapped around in a drum journaled in the sub-frame the ends of the cable being attached to the corners of the motor frame. The drum is power operated. The throttle and spark control are through rods running to the bar in front of the operator, and the high, low, and reverse rods occupy a similar position on the other side of the wheel. All of

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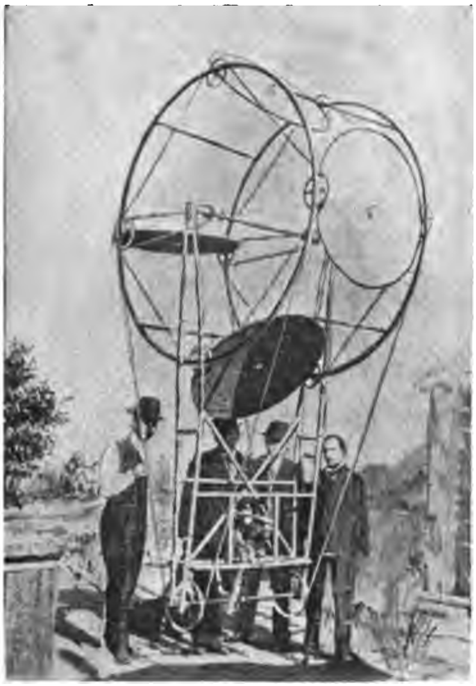
these control handles are carried on a bar, which is supported in such a way that it may be raised or extended to come in convenient reach of the operator at all



A NOVEL FLYER—THE AEROCYCLOID.

times and will swing when turning corners.

This new gasoline tractor was suggested by the frequent call for a light farm tractor that would take the place of the two, four or six-horse teams used in plowing, harrowing and hauling required on California ranches. It is particularly an orchard tractor.

THE IRVINE AEROCYCLOID

JOHN C. IRVINE, of San Francisco, has recently devised a new type of flying machine. This aerial device is known as an "aerocycloid," and combines the air-resisting principles of the parachute, the kite, and the gyroscope.

Though Irvine has been working on his device for more than three years, he has only very recently perfected it. It consists of two upright wheels revolving on a fixed supporting shaft. These wheels are built on the bicycle principle —of the lightest and strongest construction known. The shaft connecting the two wheels is stationary with the uprights and has a sprocket wheel on each end carrying chains over sprocket wheels attached to the rim of one of the aerial propellers. By this arrangement these propellers are given the proper tangent in relation to the large wheels. The larger wheels are six feet in diameter, and the smaller, or aeropropeller wheels, or disks, are three feet in diameter.

When the wheels revolve the machine rises, and when the desired elevation is attained the aeropropellers are given a certain dip or angle by means of the shaft. This tipping of the planes is designed to cause a downward and backward deflection of the current of air which has been created by the propellers, and, as a result, the machine will travel backward or forward, at the will of the operator.

The device descends by a lessening of the revolutions of the wheels, and one of the great advantages claimed for the "aerocycloid" is that it can hover in the air, move up and down in vertical lines, and remain stationary at any elevation. Another advantage claimed is that this machine can rise vertically, or at any desired angle, and does not require to be moving at a high rate of speed, like the aeroplane before ascending. It can ascend in the midst of houses or timber without difficulty.

Irvine has made repeated tests with a model he has constructed, to demonstrate its lifting and sustaining powers. These tests have all proved very successful. Only a 3-horse electrical motor was used; and it was repeatedly demonstrated that each horse power would lift and sustain indefinitely about 30 pounds —or 90 pounds totally.

HEAVIEST LOCOMOTIVES EVER BUILT

WEIGHING over thirty tons more than the heaviest locomotives ever before known in the history of railroading are "Harriman's Twins," completed

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at the Baldwin Locomotive Works in Philadelphia for heavy freight traffic on the Southern Pacific Railroad in the Far West. Each of the giants, including tender, weighs within a few pounds of 300 tons when loaded, of which 390,000 pounds, borne by the sixteen driving wheels, gives each a tractive force approximating 95,000 pounds.

The steam is superheated while passing from the high pressure to the low pressure cylinders. In addition to sixteen driving wheels each engine is supported by two pairs of smaller wheels, one pair forward of the drivers and the other back of them. Eight wheels are used on the tenders. Oil is used for fuel, the tenders carrying 2,850 gallons in ad-

ONE OF THE TWO HEAVIEST LOCOMOTIVES EVER BUILT.

dition to 9,000 gallons of water. Steam is used at a pressure of 200 pounds.

The engines belong to the Mallet articulated type, named for the inventor, Anatole Mallet, a French engineer, and called "articulated" because the frame is jointed midway, the forward wheels constituting a truck, which swings about the fulcrum pin when the engine is rounding a curve. Thus, although the total wheel base is almost double the length of ordinary locomotives, the rigid wheel bases are short and engines of great length and power can successfully traverse sharp curves at high speed.

Each group of eight driving wheels—four on a side—is operated by a separate pair of cylinders, arranged on the compound system, the steam first entering the rear pair through the big steam pipe shown on the outside of the boiler in the accompanying illustration and then passing through a flexible pipe to the front, or low pressure, cylinders, which are the largest ever placed on a locomotive, being forty inches in diameter.

An interesting feature of the engines is that they are separable, the boilers being built in two parts, which are bolted together. By taking out the bolts, removing the frame fulcrum pin and disconnecting the longitudinal pipes, all of which are equipped with unions, the engines are readily separated into two sections, to facilitate the handling of the parts when making repairs. This arrangement was tested in the shops of the builders and proved to be feasible.

Some of the other dimensions which give an idea of the engines' enormous size are: Boiler diameter, 84 inches; total heating surface, 6,393 square feet; diameter of driving wheels, 57 inches; length over all, 93 feet 6½ inches; weight on driving wheels, 390,000 pounds; weight of total engine, 430,000 pounds; weight of total engine and tender, 600,000 pounds.

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One on the Professor

"HAS anything ever been discovered on Venus?" asked the student of astronomy.

"No," replied the old professor, whose mind

had slipped a cog and transported him into mythological fields, "not if the pictures of her are authentic."—*Ladies' Home Journal.*

Where He Slept

A PROSPEROUS farmer sent his son to New York to begin life as a clerk. After he had been in the metropolis for six months the farmer wrote the merchant to ascertain how his son was getting along and where he spent his nights. In due time the merchant sent a reply to the farmer which read:

"Your son sleeps in the store in the daytime. I don't know where he spends his nights."—*The Circle.*

A Principle of Law

AMONG the witnesses summoned to the trial of a negro in a Southern city was a big dusky belle. When she took the stand the usual question was put to her:

"How old are you?"

Whereupon the lady grew indignant, and appealing to the judge, said:

"I understands, jedge, from my limited knowledge of de law, dat no lady is expected to testify ag'inst herself!"—*Harper's Magazine.*

Domestic Scheme

MRS H.—"Why are you so very fond of Oriental rugs?"

MRS. R.—"I'll tell you a secret. The dirtier they get, the more genuine they look. You've no idea how much sweeping that saves."—*Cleveland Plain Dealer.*

A Coincidence

ON the notice board of a church near Manchester the other day the following announcements appeared together. A potato pie supper will be held on Saturday evening. Subject for Sunday evening, "A Night of Agony."—*Manchester Guardian.*

A Proviso

BRIDE—"Here is a telegram from papa."

BRIDEGROOM (eagerly)—"What does he say?"

BRIDE (reads)—"Do not return and all will be forgiven."—*Chicago Record-Herald.*

The Reason

FIRST STRAP HANGER (in a whisper)—"Why did you give that woman your seat? She isn't bundle laden, tired, or pretty, or even polite."

SECOND S. H.—"Well—er—you see—she is my wife."—*Harvard Lampoon.*

Naturally

A RECENT examination paper at the Sheffield Scientific School at Yale contained the question, "What is the office of the gastric juice?" And the answer on one paper read:

"The stomach."—*Everybody's.*

Wouldn't You Be Mad?

RICHARD MANSFIELD asked a friend who had just seen "Hamlet":

"Now tell me, do you think Hamlet was mad?"

"I certainly do," he replied. "There wasn't a hundred dollars in the house."—*Success Magazine.*

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The Climax

He was telling a thrilling story out of his wallet of a thousand and one hairbreadth escapes over in Santiago, doncherknow, and his pretty listener was leaning anxiously toward him, hanging on his every utterance.

"The wolves were upon us," he said, "bellowing and roaring, as I have so often heard them. We fled for our lives. I don't deny it; but every second we knew the ravenous pack was gaining on us. At last they were so near that we could feel their muzzles against our legs—"

"Ah!" gasped out the lady. "How glad you must have been they had their muzzles on!"—*Answers.*

Gratifying

"One-half of the world does not know how the other half lives."

"Well, it is gratifying to think that one-half of the world attends to its own business." —*Puck.*

For Herself Alone

Host (at his wife's reception)—"Ah, my dear Mrs. Brown, aren't you coming? Everyone is expecting you. . . . Oh, never

mind about your dressmaker and your gown. . . . It's not your clothes we want to see, it's you."—*Harvard Lampoon.*

Worth Going to Jail for

Judge (at the close of a trial)—"Prisoner, you may have the last word."

Prisoner (turning to wife in the audience) —"Do you hear that, old lady?"—*Meggendorfer Blaetter.*

A Pirate

"What do you think of Miss Calihope's voice?" whispered the tall girl with the mountainous pompadour.

"She sings like a pirate," growled the rude man in the starry vest.

"Like a pirate? Gracious! And what is the resemblance?"

"She's rough on the high C's."—*Chicago Daily News.*

Still Hope

Fred—"My dear Dora, let this thought console you for your lover's death. Remember that other and better men than he have gone the same way."

Bereaved One—"They haven't all gone, have they?"—*Puck.*

A Limited Menu

The guest glanced up and down the bill of fare without enthusiasm.

"Oh, well," he decided finally, "you may bring me a dozen fried oysters."

The colored waiter became all apologies.

"Ah's verry sorry, sah, but we's out ob all shellfish 'ceptin' aigs."—*Everybody's.*

A Precaution

Lady—"Will you send this rug on approval?"

Salesman—"Certainly, ma'am."

Little Girl (who is with her mother)—"Hadn't you better tell him to be sure and get it there on time, mamma? You know we give the party tomorrow night."—*Life.*

Had Heard Him Mentioned

It was at a White House reception that a Philadelphian picked up a choice gem which he never tires of telling.

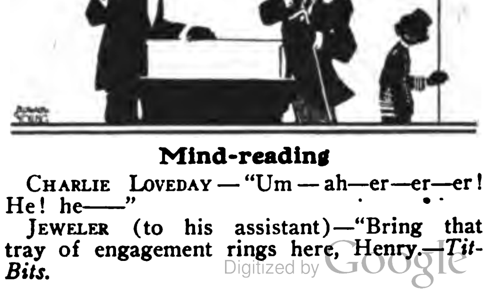
A charming girl of eighteen, the daughter of a Western publisher and quite a society queen in her own city, had been brought to Washington by her father, and at one of the White-House receptions was presented to President Roosevelt.

As her small hand disappeared within the hearty grasp of the President the maiden looked up at him and smiling sweetly said: "I'm awfully glad to meet you, Mr. Roosevelt. I've often heard father speak of you."—*Philadelphia Times.*

Not Her Fault

"It is the duty of every man and woman to be married at the age of twenty-two," said the lecturer.

"Well," said a woman of thirty, with some asperity, "you needn't tell me that. Talk to the man."—*Philadelphia Ledger.*



Mind-reading

Charlie Loveday — "Um — ah—er—er—er! He! he——"

Jeweler (to his assistant)—"Bring that tray of engagement rings here, Henry.—*Tit-Bits.*

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HUGE FORTUNE IN SMALL BULK

ONE of the largest sums of money ever handled in one bulk in Texas was paid into the state treasury a short time ago by the Waters-Pierce Oil Company in full settlement of the fine assessed against it by the courts for violating the anti-trust laws of that state. The sum aggregated $1,808,843, and, with the exception of a few hundred dollars, all of it was in currency.

The delivery of this money to the state treasury of Texas was devoid of sensational incident. It had been shipped from New York to Austin and placed in two different banks a few days before the formal payment was made. The money was placed in a sack and conveyed to the state capitol in an automobile, which made the run at a terrific rate of speed. The sack was quickly carried into the treasury and placed behind iron bars.

The count of the money occupied but a few minutes. A photograph was then taken of the money spread upon a table, with a number of state officials and spectators standing around. E. B. Perkins of Dallas, Texas, attorney for the Waters-Pierce Oil Company, who made the transfer of the money on behalf of that company, is seated on the extreme left, and seated next to him is Attorney General R. V. Davidson.

In the package standing erect is $1,200,000. It consists of 120 bills each of the denomination of $10,000.

WALLS OF JERICHO DISCOVERED

DR. SELIN, the well-known Austrian archæologist, has unearthed in Palestine the remains of the supposed

CORPORATION FINE COLLECTED BY TEXAS.
The sum of $1.808.483 is upon the table.

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THE WALLS OF JERICHO.
Sections of walls of different periods, the lower believed to be from Joshua's time.

ancient city of Jericho—that city whose walls fell so miraculously before the trumpet-blasts and shouts of Joshua's army. The site of the excavations is a collection of mounds in the vicinity of Ericha, near the Dead Sea. After digging to a depth of only eight feet the excavators came across the exterior or outer wall of the vanished city. They were surprised at the technical excellence of its construction. The natural rock foundation is overlaid with a filling of loam and fine gravel, a meter or so deep, upon which a sloping rubble wall, heavily bulging externally, is superimposed to a height of 20 feet, and having a breadth of from 6½ to 8 feet. The wall is built of well-laid rubble which becomes finer towards the top. Enormous blocks are partially employed for the lower parts of the wall. Upon this comes the fortification wall proper, built of clay bricks. In one place this part of the wall reaches a height of eight feet, but it would seem to have been considerably higher. At the corners were found the remains of what were evidently huge towers or ramparts. The whole must have been a most striking structure which dominated the whole plain without the city and visible for miles. The wall is believed to have extended in the form of an oval for a distance of about 900 yards. Some 450 yards have already been laid bare since the excavations were begun in the winter of 1906.

BIG WEALTH IN A DESERT WEED

THE manufacture of wax from the candelilla weed is now an industry of much commercial importance in northern Mexico and steps are being taken to establish factories for this purpose in Texas. The weed which is now being made to produce enormous quantities of wax is a desert plant which grows upon many millions of acres of the upper plateau region of northern Mexico, extending into the higher altitudes of western Texas. It is also found in considerable quantities in some parts of Arizona and New Mexico.

The process which is now used for extracting the wax from the candelilla

PILES OF CANDELILLA WEED.
The wax has been extracted.

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A STREET VIEW TAKEN FROM SIXTEEN STORIES UP.

plant was discovered by Oscar Pacius of Monterey, Mexico. He is now largely interested in the new industry. The weed grows in a cluster, the stems being leafless and growing to a height of three to five feet. There are usually from 50 to 100 of these stems growing from one root. The weed is thornless, which is something unusual for a desert plant. When cut off at the roots the plants quickly reproduce themselves. They yield more abundantly on account of frequent cuttings, it is claimed.

The weed contains 3½ to 4½ per cent of wax. The wax which is now being manufactured is sold principally in Hamburg, Germany, where it readily commands $600 gold per ton. It costs about $75 gold per ton to produce it; this leaves a very handsome profit for the manufacturer. The annual profit per acre of the weed is $200 to $300.

LOOKING STRAIGHT DOWN

THE accompanying photograph was taken from the sixteenth floor of the Frick Building, Pittsburg, Pa., by holding the kodak out of the window and pointing it straight down. The side of the building forms half of the picture and the thoroughfare — Grant Street— the remainder, on which can be seen pedestrians, automobiles and wagons.

FRENCH AERO MOTOR OF LIGHT WEIGHT

THE accompanying illustrations show the construction of some extra-light motors of French design for airship appliances as constructed at Asnieres. The three-cylinder air-cooled motor has been accepted by the French government for its military aeroplane. This engine has a working weight complete of 220 pounds. The three cylinders are all mounted above the center of the crank shaft as indicated and have a stroke of 150 millimeters and a diameter of 135 millimeters.

A somewhat smaller engine is constructed developing twelve horse-power, this aeroplane motor also having three cylinders of the air-cooled type measuring eighty-five millimeters in diameter with a stroke of eighty-five millimeters. This air cooled engine operates at a speed of 1800 revolutions per minute and weighs in working order about eighty pounds.

In addition to the air-cooled aeroplane

SIX-CYLINDER FRENCH AIR-COOLED AERO MOTOR.

THREE-CYLINDER FRENCH AIR-COOLED AERO MOTOR.

engine a six-cylinder water cooled motor has been designed, the cylinders being arranged in three pairs taking relatively the same position as the three cylinders of the air cooled type.

The six-cylinder engine weighs somewhat more than the air-cooled type of the same capacity, developing fifty horse-power with a weight of 240 pounds when complete in working order. The diameter and stroke of the cylinders are 100 millimeters and 120 millimeters respectively and the speed of the water-cooled motor is 1600 revolutions per minute. While many experimenters with airship appliance are favorable to air-cooled motors others believe that water-jacketed engines are the most reliable, and the latter type of engines has been constructed to meet the requirements of these operators of aeroplanes and dirigible balloons.

It is believed that these French light weight motors are quite a step in the direction of producing a satisfactory aero motor.

THE MAKING OF ALABASTINE

A GOOD many years ago, a young Englishman settled in the sparsely populated valley of western Michigan on the banks of the Grand River. One day in walking over a newly acquired bit of land he noticed an outcropping of a familiar crystalline substance. He hit it in an inquisitive way with his walking stick and the softness of the material reminded him of a similar experience under the sunny skies of Italy. He had found alabaster rock, from which alabastine is made.

Beds of it underlie and overlie many acres in Kent County, Michigan. Some is on the surface and extends downward a score of feet beneath the surface and open quarries are used in the work. Again, the rock is closely guarded by over-lying soil and lies many feet beneath the surface, so that tunnelling is essential.

Tearing the substance loose is accomplished by blasting, which breaks the rock up into large chunks.

These chunks, each as big as a pig's head, are carried to the crushing mill where they are ground up into small

A HEAP OF CRUDE ALABASTINE.

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TABLET SHOWING CORRECT ALTITUDE OF PIKE'S PEAK.

pieces, these to be passed between immense stones and ground to still further fineness. Now the crystals are ready to be carried to the kettles for the purpose of calcining.

The fine crystals are thrown into the kettles, fire applied beneath and the innate moisture of the rock is, when subjected to the intense heat, sufficient to change the mixture into a seething mass or fluid; the boiling occurs at 380 degrees of heat.

Now the material is ready for the addition of the coloring pigments. These pigments come crude in form and coarse in shape; they too, are ground and reground, tested and refined.

Large mechanical arms stir and mix all together, throwing the powdered mass hither and thither until the color particles and white particles are thoroughly blended and the desired color is uniformly distributed. The resulting product is alabastine.

PIKE'S PEAK CORRECTLY MEASURED

ONE of the triumphs of the United States Geological Survey last year was a resurvey of famous Pike's Peak, which accurately established the height of its topmost rock as 14,109 feet above sea level. In the early days of the development of the Golden West the peak was thought to be the highest in the country. But measurements showed several others which overtopped it, it even being lower than two of its near neighbors.

Along about 1884 its height was estimated by a barometer to be 14,216 feet, later the Signal Service of the army placed it at 14,147 feet, then the Coast Survey declared it to be 14,108 feet, and this was disputed by Weather Bureau experts, who claimed a height of 14,111 feet.

Beginning their work in 1907, a party of Geological Survey men started from a benchmark in Manitou, near the foot of the famous Pike's Peak cog railroad, and ran a line of levels to the summit and then across and down to a point on the railroad. During the winter of 1907-08 the work was halted by the ice and snow, but it was resumed again in the spring and completed in September, after which the tablet which our illustration shows was erected on the highest rock. The figures which it shows are not expected to be again disputed.

The expenditure of such an amount of labor seems hardly justified but if mountains will thrust themselves in our midst, it is perhaps best we should have an accurate register of their altitude.

THE SUMMIT OF PIKE'S PEAK.
Tablet in rock and geographer, E. C. Barnard, who set it

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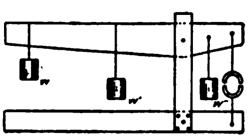
Are you puzzled by any question in Engineering or the Mechanic Arts? Put the question into writing and mail it to the Consulting Department, TECHNICAL WORLD MAGAZINE. We have made arrangements to have all such questions answered by a staff of consulting engineers and other experts whose services have been specially enlisted for that purpose. If the question asked is of general interest, the answer will be published in the magazine. If of personal interest only, the answers will be sent by mail, provided a stamped and addressed envelope is enclosed with the question. Requests for information as to where desired articles can be purchased will also be cheerfully answered.

To Test Cement

Describe a simple method of testing cement. —*N. R. S.*

There are a large number of testing machines for cement in use at the present time, but practically all of them are expensive. A cheap home-made testing machine may be made by any ordinary mechanic at small expense, as shown in the cut. Counterpoise a wooden lever 10 feet long 20 inches from one end between two broad uprights and working on a horizontal pin. The top of the arm is to be grooved so that a wheel supporting the weight W′ can roll back and forth. Mark on the surface of the lever the distance from the fulcrum in feet and inches and also the corresponding effect of the weight at each point. Clamps of wood should be fastened on clevis points to the lever arm and bed plate respectively, and are for holding the briquette in suspension from the short arm 18 inches from the fulcrum. The pinholes should be reinforced by iron wires and an iron pin should be used. Extra weight can be hung on the end of the arm where great stress occurs. Start at zero when applying the load to briquette and increase regularly at about the rate of 200 pounds per minute, for natural cements and mortar, and double this amount for neat Portland cement. With this machine pressures of about 3,000 pounds have been developed. A rough and simple test may be made by hanging a bucket from a clamp on the under side of a briquette, the upper clamp being suspended from a beam, and then run sand into the bucket until the briquette breaks and then weigh the sand.

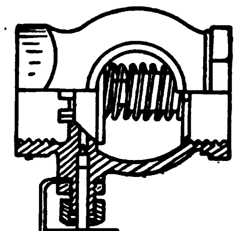


METHOD OF TESTING CEMENT.

Vaporizer for Automobile

What is the simplest form of vaporizer for use on an automobile?—*E. T. D.*

There is no simpler form than the one shown in the cut. It consists of nothing more than a special check valve in the seat of which a small opening fitted with a small needle valve has been made. The air enters at the top and the suction of the engine opens the check valve, thus causing the gasoline to flow. A slight suction is produced on the gasoline by the draft of air entering and the gasoline spreads over the conical surface of the valve and becomes well mixed with the air. One of the important points is to get the needle valve as close to the opening as possible. This will cause the draft to be beyond the needle valve and not from a small reservoir of gasoline. This is especially important in cases where the load is likely to be suddenly changed.



AN AUTO VAPORIZER.

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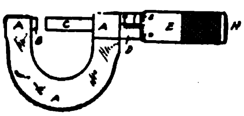
To Read a Micrometer

Explain the operation of a micrometer and how it is read.—*W. L. E.*

The cut shows the usual form of a micrometer, the parts of which are as follows: A—frame, B—anvil, C—spindle, D—sleeve, E—thimble. The spindle is attached to the thimble at the point H, and the part of the spindle which is concealed within the sleeve and thimble is cut to fit a nut in the frame. Now, holding the frame stationary, the thimble is revolved by the thumb and finger and the spindle being attached to the thimble revolves with it and moves through the nut in the frame, approaching or receding from the anvil. The article to be measured is placed between the anvil and the spindle and measured on the opening between the anvil and the spindle, as shown by the lines and figures on the sleeve and thimble. The pitch of the screw thread on the concealed part of the spindle is 40 to 1″. One complete revolution of the spindle, therefore, moves it longitudinally 1/40 of an inch which equals twenty-five thousandths of an inch. The sleeve is marked with 40 lines to the inch according to the number of threads on the spindle. When the micrometer is closed the beveled edge of the thimble coincides with the line marked zero on the sleeve and the zero line on the thimble agrees with the horizontal line on the sleeve. Open the micrometer by revolving the thimble one full revolution or until the zero line on the thimble again coincides with the horizontal line on the sleeve. The distance between the anvil and spindle is then 1/40 or .025 of an inch and the beveled edge of the thimble will coincide with the second vertical line on the sleeve. Each vertical line on the sleeve indicates a distance of 1/40 of an inch. Every fourth line is made longer than the others and is numbered 0, 1, 2, 3, etc. Each numbered line indicates a distance of four times 1/40 of an inch or 1/10 of an inch. The beveled edge of the thimble is marked in 25 divisions and every fifth line is numbered from zero to 25. Rotate the thimble from one of these marks to the next, moving the thimble longitudinally 1/25 of twenty-five thousandths or one thousandth of an inch. Rotate it to the division indicating two-thousandths, etc. Twenty-five divisions will indicate a complete revolution or 1/40 of an inch. The method of reading a micrometer is, therefore, to multiply the number of vertical divisions visible on the sleeve by 25 and add the number of divisions on the bevel of the thimble from zero to the line which coincides with the horizontal line on the sleeve. For example, in the cut 7 divisions are visible on the sleeve. Multiply this number by 25 and add the number of divisions shown in the thimble which is 3. This will give 7×25 which equals 175. 175 plus $3 = 178$. The micrometer is open one hundred, seventy-eight thousandths.

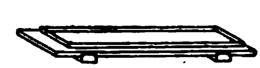


A Form of Micrometer.

To Remove Wrinkles from Drawing Paper

In what way can wrinkles be taken out of drawing paper in order to make it lay smooth on the drawing board?—*T. H. F.*

The drawing paper should be stretched tight on the drawing board and a good method to use is as follows: cut a small square half-inch section from each corner of the drawing paper and then turn upright a half-inch border, giving a sort of pan effect, as shown in the figure. Sponge water over the sheet carefully, keeping the upright border as dry as possible. Apply paste on the outside of the upright border and then paste this border carefully down on the drawing board, one edge at a time, and using some lateral pressure in order to stretch the damp part as much as possible. Stand the board aside and allow the paper to thoroughly dry. You will then find it to be stretched perfectly tight and ready for work. After the drawing has been completed it can be cut out by the use of a sharp penknife and a straight edge. The border remaining on the board can then be scraped off.



Board to Stretch Drawing Paper.

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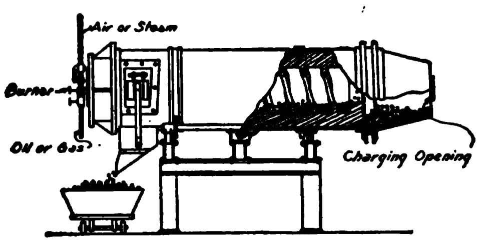
To Harden Steel Balls

Is there any kind of machinery in operation by means of which steel balls can be hardened very uniformly? If so, please give description of apparatus.—*N. A. T.*

For the so-called rotary annealing and hardening furnace it is claimed by the manufacturers that a uniformly heated and clean product results.

A cylindrical furnace with a smooth fire tile lining of helical form, fired internally with oil or gas fuel, rotates at certain fixed speeds and charges and discharges automatically. The only human parts of the operation are the firing and the feeding. Both are easy. Oil or gas fuel requires observation rather than labor. The feeding is mechanical rather



METHOD OF HARDENING STEEL BALLS.

than manual. A pyrometer tells the degree of heat; a speed regulator fixes the time of exposure. The material is charged into the hopper in bulk and is conveyed through the furnace automatically to the discharge end, where it reaches its ultimate temperature. The material is brought up to the desired temperature gradually so as to afford time for the heat to penetrate its mass without overheating its surface parts.

If the furnace is to be used for hardening, a quenching tank is fitted below the discharge spout, the tank containing a conveyor driven from the furnace drive, so that as the material is discharged from the furnace into the hardening bath it is caught on the conveyor, brought out and discharged over the end of the tank into a truck or wheelbarrow.

The furnace body consists of a cylindrical steel shell with one longitudinal seam, and with steel flanges at each end, to which are bolted the flanged cast iron end pieces. The casting on the discharge end has an opening through the axis for the introduction of the fuel from the burner and for the admission of air for combustion, which is regulated by a revolving damper. All other details are easy to understand from the accompanying sketch.

The lining of the furnace is one of its chief features. It is helical in form, made of special hard smooth fire tiles of simple design. The furnace may be driven either by a pulley or sprocket wheel from a variable speed countershaft.

The speed may be varied according to the kind, shape, and quantity of material being heated and is under control. Ordinarily, from one to three revolutions of the furnace per minute is the practice, and the time of travel of material through the furnace from 3 to 10 minutes.

The furnace is intended to handle, either for annealing, hardening, or tempering, all small pieces of like dimensions in either brass, copper, steel, or other metals, such as cartridge shells, eyelets, buttons, caps, steel balls, tacks, screws, rivets, rings, springs, nuts., etc., in fact, any small pieces which will travel freely and pass through openings without shocking.

To Blue Steel Screws

How can I blue steel screws?—*N. F. A.*

First see that your screws are made of steel, and not iron. Next smear them over with a little common soap—this prevents their scaling—and make them a dull red heat, and quench in water. Then if you have a screw-head tool, such as watchmakers use, put them into that and with a piece of stone first, and afterwards crocus, bring the head up to a polish. Finish off with rouge on a buff, and see that there is no grease left on them. Now take a piece of thin brass, make some holes, into which drop the screws, say half a dozen, and hold them over a lamp, watching the color as it turns from yellow to purple, and then to blue. The finest blue is just before it turns to a slate color. They must be heated very gradually or you will not be able to stop the color turning in time.

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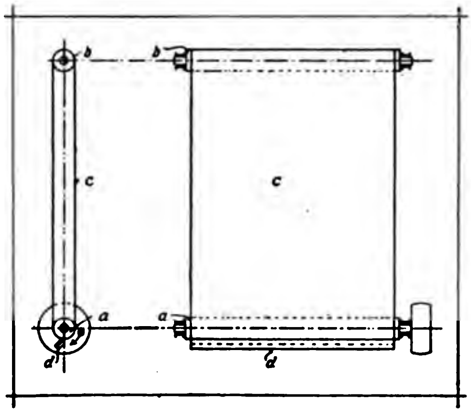


PROTECTOR FOR AUTOISTS.

Self-Cleaning Protector for Autoists

I have read somewhere recently of a self-cleaning protector for chauffeurs and motormen. Do you know of such an invention?—*C. M. E.*

A device has recently been perfected which makes possible to keep continually transparent the window or strip of celluloid in the curtain affording protection to the chauffeur. In a heavy snow or rain storm this window is often in a few minutes rendered opaque, which the invention obviates by substituting for the stationary window an endless strip of celluloid, or some other suitable material, which is kept revolving on rollers above and below and at the same time is pressed against a brush which removes the particles of snow, etc., that obstruct the vision. The power for keeping this strip in motion is derived from the engine.

In the accompanying drawing c represents the endless strip of celluloid, a and b the respective rollers and the pulley at the lower right-hand corner to receive the power from the engine, d is the brush.

What Heat and Cold Are

Can you give an exact definition of "heat" and "cold?"—*S. P. J.*

Heat and cold are merely relative terms, referring in ordinary life to the sensation of the human body. Temperatures below the temperature of our body we call "cold" and temperatures higher, "hot."

In science this definition does not hold. The relative motion of the molecules of any body is creating heat and the theory is that down to about 492 degrees Fahrenheit below the freezing point of water a perceptible motion of the molecules is present. Below this temperature, we have rest, the real cold begins.

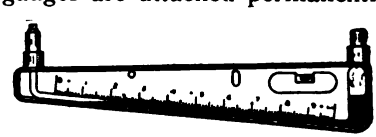
To illustrate the meaning: the householder who pays the ice trust an exorbitant number of dollars every year to keep his refrigerator cold will probably smile when you talk to him about the hotness of ice. As a matter of fact, however, ice is a hot substance, averaging 492 degrees absolute. In setting a pail of liquid air on a cake of ice, it will boil away. Ice is red-hot compared with liquid air, and the temperature of the electric furnace chilly against the temperature on the sun.

A Draft Gauge for Boilers

Please give details of the construction of a draft gauge for boilers, and how to connect it.—*N. P. B.*

A gauge consists of a frame, gauge glass, level glass and a vent plug. The frame of a 1" gauge is about 4" wide, 1" deep and 13" long. The scale has 10 graduations to the inch. The arrangements of the parts are clearly shown on the accompanying sketch. Fasten the gauge so that the air bubble in the level glass stands central between the marks. For brick walls of buildings and boiler settings, nail a board to the wall to which fasten the gauge, driving the nails in the vertical seams of the mortar. On boiler fronts, unless cool, the gauge should not be mounted.

Where the fronts are cool and where the gauges are attached permanently, as



A DRAUGHT GAUGE FOR BOILERS.

an additional protection against overheating of the oil and the liquid in the level glass, the gauge should be set away from the front by means of the draft gauge brackets, allowing air to circulate back of the gauge. For portable use, quick adjustment, drill a hole in about the center of gravity of the gauge, using one screw, which if screwed in firmly will hold the gauge in position.

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RAILLESS MOUNTAIN TRACK

By ARTHUR GARDEN

ENGINEERS are busy at work in the mountains of Switzerland, that Eldorado of tourists, where many of the most fearful peaks, the ascent of which formerly required a considerable amount of skill and courage, in addition to a not immaterial outlay, are at present accessible at a trifling cost to the traveler. Though some of the most enthusiastic alpinists may look with anger at the invasion into their realm of steam, steel and electricity, this conquest of the extreme heights should be heartily welcomed by the real lovers of mountain scenery, both in their interests and in those of a wider circle of tourists.

Though of relatively modest dimensions, the railless track which has been recently installed on the Wetterhorn deserves a more than passing interest because of the novelty of its system which allows, at a comparatively low cost of installation, readily to deal with most considerable level differences between two points to be closed up to railway traffic.

Its construction is due to a suggestion by the late Mr. Feldmann of Cologne, under whose supervision the Elberfeld-Barmen suspended railway had been constructed. This engineer soon conceived the idea of replacing the track resting on a substantial iron structure, by a wire-rope system, thus allowing considerable heights to be negotiated without any abutments between terminals and substituting for a viaduct-suspended railway, a wire-rope suspended railway. He, however, experienced considerable difficulty in obtaining support for his idea, until Messrs. von Roll of Berne agreed to take up his plans.

The scheme designed by Feldmann, like the familiar wire-rope railway, comprises two vehicles which, however, are

TWO CARS BEARING THEIR PASSENGERS ABOVE THE MOUNTAIN GLACIERS.

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SWINGING FREELY FROM ITS STEEL CABLES, THE CAR ON THE NEW ALPINE AERIAL RAIL WAY MAKES AN ASCENT APPALLING TO THE BEHOLDER.
The upper terminal station is shown some distance above the car.

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connected by two traction cables instead of by a single cable. Whenever one of these vehicles rises, the other descends, both maintaining their mutual equilibrium. The traction cables are conveyed over the driving pulleys of a capstan, generating the traveling motion. The cars are running on what is called supporting cables fixed to the upper and lower terminals respectively of the line, the former being immovable and the latter susceptible of displacement.

Each car is running on two such supporting cables which in opposition to previous schemes, are designed below one another. This ensures a far greater stability to the cars.

At the lower movable end, the supporting cables run into a pit where a suspended weight keeps the cable tension constant. The weight is susceptible of rising and descending in the pit and allows the supporting ropes under variable loads on the car to take up such positions as will keep the terminal tension of the supporting ropes constant. It may be said that those arrangements have given excellent results in actual practice, coming up to any hopes attached to them.

In addition to comprehensive safety devices, the cars themselves are provided with sufficient safeguards. Their safety brakes, in the absence of other suitable organs, could be made to act only on the traction ropes.

The level distance between the terminals of the line is 420 meters while the horizontal distance is 365 meters.

The supporting cables are made of steel and are conveniently enclosed so as to be protected against moisture. A remarkable feature is the extraordinary stability of the cars when under way, no fluctuations being experienced even during storms. Each car affords seating accommodation for eight, and standing accommodation for eight persons.

In spite of its daring design, this scheme affords at least the same amount of safety as an ordinary railway and accordingly deserves the same degree of confidence.

It is intended to apply the same system to far more extensive lines, e. g., the upper section of the Jungfrau railway and the contemplated Mont Blanc railway, thus opening up wonderful new vistas to the tourist.

FLOATING DOCK SHIPS FOR SUBMARINES

By ADOLPH GUERNSEY

THE vessel, illustrated in the accompanying photograph, has recently been constructed on plans by Herr von Klitzing for the German naval harbor at Kiel, and is to serve for the rescuing of submarines. Being in itself a transportable dock, it constitutes quite a novel type of vessel and by its peculiar shape represents a departure in modern ship building.

As the illustrations show, it consists of two ship-forms, linked together fore and aft above the water line by steel girders made up of angles and plates so that a torpedo or submarine in floating condition can steam between the two forms. When in this position, the boat to be docked is lifted out of the water by the tackles and crane hooks and is then placed on beams turning on pivots which can be fixed either lengthwise or transversely, which beams are swung under the dock vessel and fastened by hinges to one of its inner sides. They are eventually pulled up against the other side as far as it is advisable to raise the docked vessel. After being repaired, the submarine is again lowered into the water.

The task of designing plans for this salvage vessel was the more difficult, as there was no practical experience with a similar vessel to fall back upon. Special interest attaches to a number of arrange-

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READY TO PICK UP A SUBMARINE.

FLOATING DOCK IN COURSE OF CONSTRUCTION.

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SMALL VESSELS MAY PASS UNDERNEATH.
Note the peculiar double-ship construction.

ments provided in this remarkable craft, some of which are mentioned in the following.

The means of propulsion of the dockship are particularly interesting. In fact, the German navy, in this case, has for the first time dispensed with the usual arrangement of propeller engines —either piston engines or turbines— using electric motors for the operation of the two propeller shafts. The power plant, in accordance with the design of the vessel as a double-part structure, consists of two identical installations, and the two propellers are driven by two electromotors, each of which is operated from a special source of power. However, the same source of power can be as well made to actuate both motors.

Each set of the power plant comprises a steam turbine which is directly connected to a continuous-current machine excited by a dynamo mounted on the same shaft. Another identical machine on the same shaft serves for feeding the propeller motor, which is started from the power plant or the conning tower through a device allowing the motors to be run, either both forward or backward, or forward and backward respectively. The boiler plant comprises four water-tube boilers designed on the Mehlhorn system in which the heating gases and boiler water are guided approximately according to the back-current system. A double-action wet-air pump with simplex steering and a double-action dry-air pump are provided in each engine room for operating the condenser plant.

All the switches and controlling mechanisms for the whole of the machinery are operated from the bridge, thus necessitating no intercommunication between the commanding officer and the engine room.

Owing to the very satisfactory results of the trial runs the construction of a similar dockship of larger size for the other naval harbor is said to be contemplated.

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CARTOONS IN STONE

By O. H. SAMPLE

FEW forms of decorative sculpture are more quaint and interesting than the old gargoyles and grotesques of the ancient European cathedrals, and modern efforts in this form of architectural decoration are so rare as to lend particular charm to the fine grotesques modeled by Sculptor L. O. Lawrie, assisted by Finn H. Frolich, for the new Cadets' Barracks of the United States Military Academy at West Point.

There are fifty-six of these remarkable cartoons in stone on the exterior of the structure designed in an orderly series to depict in humorous fashion the history of militarism from the early ages to the present, and the accompanying photographs of two of them show a richness and humor of expression seldom seen in architectural decoration.

They take the form of sculptured cartoons of military symbolism or fanciful burlesques of the standard figures of victories, soldiers and war heroes so expressively rendered that the historic types may readily be recognized.

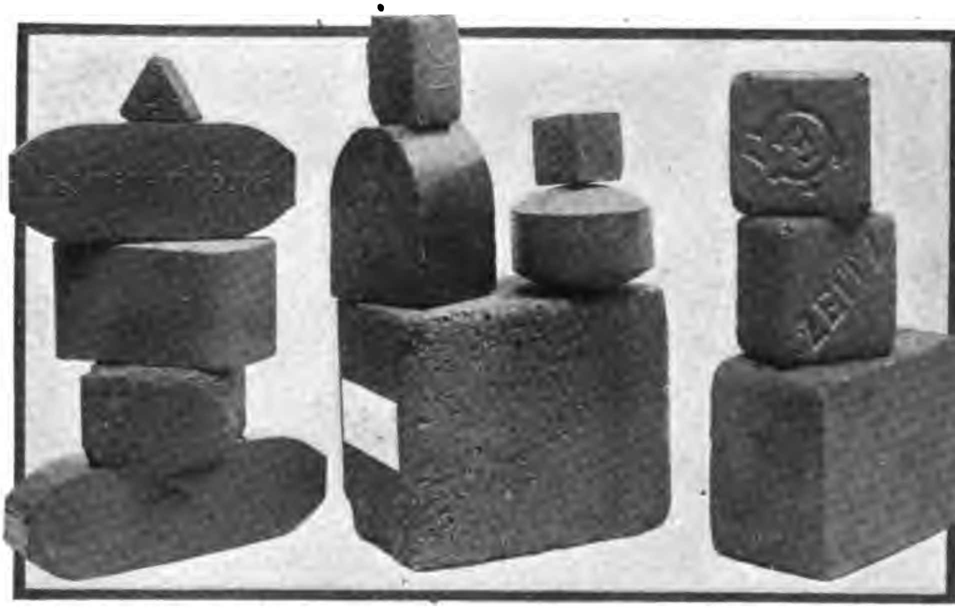
There is the stealthy red man, bent double, aiming his tomahawk and stealing upon the unsuspecting white man. Another caricature of the Indian shows a wry-faced savage pointing at a canteen which he supports on his knee.

AN INDIAN BRAVE ON THE WARPATH.

AN EGYPTIAN WARRIOR.

The massive Egyptian countenance, with fierce supercilious features and finger pointing haughtily at an emblem, and the Roman warrior, crouching behind his shield, wrinkling his stern brows at the enemy, are also equally well done.

The Colonial hero is seen bending double and supporting himself on one hand, grasping a big ungainly pistol in the other. The early Anglo-Saxon type is portrayed in a frightened imp who hides entirely behind his shield, his nose barely protruding over the top, and his knotted club standing erect at one side.



TYPES OF FOREIGN AND DOMESTIC BRIQUETS.

COMING OF THE COAL BRIQUET

By GUY ELLIOTT MITCHELL

TO the traveler through the great coal-mining regions of Pennsylvania and West Virginia, familiar with the huge piles of discarded coal dust—slack or culm, as it is called—which break the sky line in many directions, the estimates which have been stated in terms of millions of tons of burnable coal wasted every year in this manner do not appear excessive, nor do even the statements that hundreds of millions of tons have been so wasted since the beginning of the coal mining industry in the United States. Coal dust waste is by no means all visible, since in the bituminous or soft-coal districts what would amount in the aggregate to fair sized mountain chains of unmarketable "slack" has been allowed to burn up in order to get rid of the accumulations. In some instances the piles have been deliberately fired.

Future wastes of this character, however, are likely to diminish and in time disappear, since the briqueting industry is at last establishing a foothold in America and recent government tests have demonstrated beyond question the great efficiency of the briquet for certain fuel needs.

Briquetting of coal-dust and lignites has been carried on for many years in Europe and has reached the highest stage of development in France, Belgium and Germany, the latest figures from Germany showing an annual manufacture of about 15,000,000 tons of briquets from coal-dust and waste. In the United States the industry has not in the past developed for two reasons: with our tens of millions of acres of coal beds, from which in most cases coal can be mined very cheaply it has usually been more economical, from the standpoint of immediate profit, to waste the slack or culm than to save and market it at the additional cost of briquetting. The sec-

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HILL OF CULM AND INFERIOR GRADE COAL.

ond reason for failure to utilize this waste resource, which is analogous to the first, has been the definite opposition shown by some of the coal operators to the introduction of a manufactured fuel which would come into competition with the commercial output of the coal mines and constitute a disturbing factor in the nice balance maintained in prices by the mine owners. The first step in the utilization of mine waste has, however, been taken by the operators themselves and the slack piles are no longer ruthlessly fired and intentionally burned up. It has been found profitable to work them over, screen out the small coal and use the dust for filling in empty mine chambers. Even this latter is most wasteful, involving the loss for all time of great quantities of high grade carbon. This first step toward making a questionable use of a valuable commodity might have been the last, for a long time anyway, had not the government investigations, begun at the St. Louis Exposition and continued since, stimulated the question of briquet making. As the situation stands today, the briquetting industry is on the increase, and as the superiority of the briquet becomes more fully recognized the demand for it will force the utilization of mine waste. During the last few years a number of briquetting plants have been established, over a dozen "factories" being in operation at the present time. The optimistic statement is now made by Edward W. Parker, chief of the division of Mineral Resources of the United States Geological Survey, that the preliminary period of failure and discouragement in the manufacture and use of briquet fuel has apparently passed and that the industry

Where Briquets Are Moulded.

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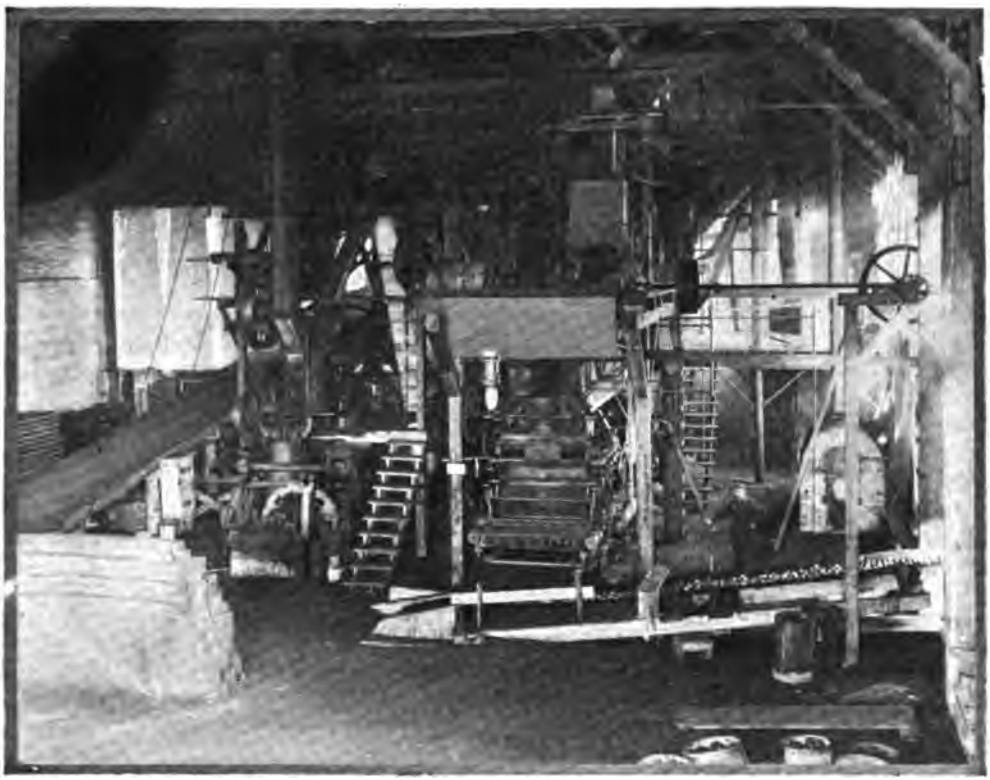
will be placed on a substantial footing. Certain it is that if recent exhaustive tests of the fuels testing division of the Survey are to be considered, briquetted coal for use at least by railway locomotives and steamships has a great future. Briquets are shown to have produced greatly increased energy and under forced draft proved themselves much more nearly smokeless than run-of-mine coal of the best quality. Indeed, it has been predicted that the war vessel of the future will have its smoke problem solved as effectually as has been the smoke question on the firing line since the introduction of smokeless powder.

In sixteen complete test trips on the Atlantic Coast Line Railroad with briquets as against run-of-mine coal, and covering an aggregate of 1,984 miles, the briquets proved superior in every respect. The tonnage of briquets consumed was less, as compared with the coal and the number of miles run was greater in favor of the briquets. The use of the briquets did away with all black smoke, no clinkers were formed and the briquets burned completely. In these tests 172,700 pounds of coal were consumed in running 10,912 car miles, as against 161,980 pounds of briquets in running the greater number of 12,896 car miles. Reduced to pounds consumed per car mile, the figures are 15.8 pounds of coal for each car mile, as against 12.5 pounds of briquets for each car mile. With briquets furnished at the same price as coal, this would mean a saving, on the basis of the estimated coal consumption by the railroads of the United States, of 30,000,000 tons of coal annually. The greatest showing for the briquets, however, lay in the fact that it was possible to get a much hotter fire than the highest limit of the coal, thus enabling the trains to make faster time



TWO TYPES OF BRIQUETTING MACHINES.
American on right; German on left, at United States Geological Survey fuel testing plant, St. Louis.

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LOCOMOTIVE RUNNING AT HIGH SPEED, USING BRIQUETS.

than was possible with coal, and in these particular instances to make up much lost time. To be able to accomplish this or to establish a faster schedule, the great passenger systems, as is well known, are willing to go to almost any expense.

Other tests made by the Geological Survey in co-operation with the Chesapeake & Ohio Railroad demonstrated that the briquets ignited more freely than coal, therefore firing up quicker and making an abnormally hot fire, and when the engine was running at speed emitting practically no smoke. A heavy fire could be carried without danger of clinkering, few ashes were left in the fire-box and the cinder deposit was very small, thus indicating almost complete combustion. Still further tests made in co-operation with the Missouri Pacific, the Michigan Central, the Rock Island, the Burlington, and the Chicago and Eastern Illinois Railroads,—amounting to one hundred locomotive tests,—show that in nearly every instance the briquets gave a higher efficiency than natural coal. For example, coal from Oklahoma gave a boiler efficiency of 59 per cent, whereas briquets made from the same coal gave an efficiency of 65 to 67 per cent. Decrease in smoke density, the elimination of clinkers and the apparent decrease in the quantity of cinders and sparks are named as the chief reasons for this increased efficiency.

Very exhaustive tests were carried on by the Survey with a locomotive mounted at the testing plant of the Pennsylvania Railway Company at Altoona, Pa., resulting in the same story favorable to the briquet. From these tests the following conclusions have been published by the government:

"The briquets made on the government machines have well withstood exposure to the weather and have suffered but little deterioration from handling. In all classes of service involved by the experiments the use of briquets in the place of natural coal appears to have increased the evaporative efficiency of the boilers tested. The use of briquets increases the facility with which an even fire over the whole area of the grate may be maintained. In locomotive service the substitution of briquets for coal has resulted in a marked increase in efficiency, in an increase in boiler capacity, and in a decrease in the production of smoke." It is especially noted that a careful firing of briquets at terminals is effective in diminishing the amount of smoke produced. For instance, in certain of the tests the figures show an average density of smoke stated for coal at 1.7, whereas for briquets it is but .62.

In similar tests made on the torpedo boat destroyer *Biddle*, a very great increase in boiler capacity resulted from the use of briquets, no such heat

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SAME ENGINE USING RAW COAL.

ever having been previously generated through the use of coal, the briquets consequently making possible a much higher rate of speed for the destroyer. Never before had the *Biddle* run so fast as during these briquet tests.

In Belgium, the briquet is considered a more serviceable form of fuel than coal. On the state railways natural coal is used more or less for freight service, but briquets are used exclusively for passenger service. In Germany it is stated that the briquet constitutes a fuel which can be handled and stored with greater facility and with less loss than natural coal, that the briquet is of satisfactory thermal value and that its use conserves the country's resources. In France the briquet is largely used and is purchased by the Government roads under definite specifications.

A feature of the briquetting industry in this country which has been discussed with the Geological Survey experts, and has been to some extent tried, is the utilization of the great quantities of coal dust, by briquetting, which accumulate in the coal yards of the large cities. The cost of briquetting is in the neighborhood of a dollar a ton. While this cost operates to retard briquetting at the mines, where in some instances lump coal can be produced for even less than the cost of making briquets, it is a small charge as against the value of coal at the city coal yard. The briquetting of the coal dust produced by the handling of coal at the yards of the large cities would result in the conversion of a good many million tons annually of nearly waste material into a clean, free-burning and altogether high-grade fuel.

The problem of economic briquet making is not always how to make the best possible briquet; but rather how to utilize available materials, both coal, slack and binders. There are various grades of briquettable coal and many kinds of binders. The cost of manufacture should be about 40 cents per ton; the cost of binding material varies from 20 cents to 90 cents per ton of briquets produced. The government's experiments and investigations show that when plants are situated so that it can be obtained, the cheapest binder is the heavy residuum from petroleum. This binder is available in large quantities in the southwest, where the oil has this heavy asphaltum base, and costs from 45 to 60 cents per ton of briquets produced.

Second in importance comes water-gas tar pitch, also a petroleum product, and costing from 50 to 60 cents.

Third comes coal-tar pitch, derived from coal and therefore widely available, varying in cost from 65 to 90 cents per ton of briquets. Other binders which may compete under favorable local conditions are by-products from wood distillation, by-products from sugar factories, wax tailings, pitch from producer gas, magnesia, starch, and waste sulphite liquor from paper mills, the last two, however, while cheap, not making water-proof briquets.

To find a suitable briquetting process for American lignite, such as obtains in Germany, would be a great achievement. Lignite is a low grade coal, the youngest, geologically, of the coals, anthracite being the oldest, and is found over vast areas of the west—upwards of seventy-five million acres. The Geological Survey has just established a huge machine at Pittsburg for experimenting in producing lignite briquets by simple pressure. It has been demonstrated that lignite used in a gas producer has greater heating energy and value than the best Pocahontas coal under an ordinary steam boiler, so that if the Pittsburg briquetting experiments prove successful they will open up a great new field in the Dakotas, Montana, Wyoming, and Texas, where lignites abound but which have heretofore been considered of little and only local value by reason of the tendency of this coal to crumble and slack when exposed to the air.

Briquets vary in size and shape from those approximating an egg to those considerably larger than a common brick. The small briquets burn better but the large blocks are cheaper to make and are convenient for storage. The French naval estimates show that ten per cent more in weight of briquets can be stored in a given space than of lump coal, and the British Admiralty reports give an even higher percentage.

The principal briquetting plants in the United States today are: one in New Jersey, having a capacity of 100 tons a day; one in New York with a capacity of 120 tons a day; two others in New York, with a capacity of 100 tons a day each; a Philadelphia plant, with a capacity of 90 tons a day; a plant in Scranton, Pennsylvania; a plant in Oakland, California, with a capacity of 85 tons a day; one in Stege, California—which undertakes the manufacture of briquets from a mixture of peat and California crude petroleum, and gives promise of using California oil as a domestic fuel—a plant in Clifton, Arizona, with a capacity of 25 tons a day; one in Del Ray, Michigan, with a capacity of from 100 to 150 tons a day, utilized for domestic fuel for Detroit. One recently organized company contemplates a plant convenient to some of the great lignite deposits in North Dakota, with a daily capacity of 1,000 tons.

HEAPS OF COAL SLACK IN THE VALLEY OF THE SHENANDOAH.

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SWEEPING BY ELECTRICITY

By K. H. HAMILTON

ONE after another of the familiar implements of housekeeping have retired from active service, to take their place in the museum of ancient history, as new devices presenting less tedious methods of accomplishing the same things have appeared upon the market.

Probably the most difficult utensil to dislodge from its position in the home, is the broom, for the housewife is skeptical of new contrivances and the method that produces results she can see, seems to her by far the more excellent one. Nevertheless, as with the rising of the sun comes the new day, so with other new methods of housekeeping comes the electric suction sweeper to supplant the broom.

The sweeper is a combination of carpet sweeper and vacuum cleaner, but lacks the disadvantages of either. It consists of a revolving brush similar to that of the carpet sweeper which in passing over the carpet thoroughly separates from it all dust and dirt, but unlike the carpet sweeper this device does not allow

THE ELECTRIC SWEEPER IN USE.

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a part of the dust again to fall upon the floor, but as soon as it is once released a suction fan operated by an electric motor whisks the dirt away to a bag attached to the back part of the sweeper.

As dust is one of the best known vehicles for the spread of disease germs, the carrying away of the dirt to a place where it can not contaminate its surroundings, is an important feature and should appeal strongly to everyone.

A number of attachments are provided with the sweeper for the cleaning of portions of the floor where the sweeper itself cannot be used, such as underneath steam radiators and heavy furniture, etc. Other attachments are used for cleaning wall paper, upholstered furniture and the renovating of pillows.

The cost of operation is but one cent per hour, and it seems probable that with the innumerable advantages the suction sweeper possesses its popularity will rapidly increase until it becomes one of the familiar implements in every well ordered house.

Lost

There are gains for all our losses,
There are balms for all our pain;
But when youth, the dream, departs,
It takes something from our hearts,
And it never comes again.

We are stronger, and are better,
Under manhood's sterner reign;
Still we feel that something sweet
Followed youth with flying feet,
And will never come again.

Something beautiful is vanished,
And we sigh for it in vain;
We behold it everywhere,
On the earth and in the air,
But it never comes again.

—ANON.

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RAYS OF LIFE

By ALBERT GRANDE

MANIFOLD invisible rays, and especially those of radium, are receiving an ever increasing amount of attention on the part of scientists as well as the lay public, and the very foundations of science are undergoing a profound revolution due to the discovery of so many novel phenomena.

The results of some most remarkable experiments have been recently presented by Major Darget, to the French Academy of Sciences. These refer to the investigation of a new type of rays which being localized apparently in the human brain, would constitute the first external effect safely ascertained of mental activity. Strange though it may appear to many readers, these experiments would seem likely to lead to a method of immediately observing the processes going on in other people's minds.

His researches on what he thinks to be fluids given out by living beings were commenced as far back as thirty years ago. It was not, however, before 1894 that, very much to the surprise of other persons engaged in similar studies, he succeeded in producing on photographic plates an impression due to the vital fluidum. These effects were obtained in the dark room on plates immersed in the developing bath and submitted to the action of the fingers, kept either in contact with the plate or at some distance.

The impression thus obtained was quite well defined, forming as it were a radiation starting from the finger tips. Those photographs would have been accurately like those obtained with light rays, but for their being frequently colored a red, green or yellow hue, according to the subject and the actual state of his health.

While according to those early experiments the "vital" fluid would thus seem to act like some special kind of light, Darget soon inferred from certain instances that this radiation must be of a rather different nature, being analogous in its behaviour to that of radium, Crooke's bulbs, X-rays or radio-activity.

If this hypothesis be true, the vital fluid, designated provisionally by the name of V-rays, should traverse opaque bodies such as the triple cover of black, red and white papers used to protect photographic plates.

This suggested an experiment in which a photographic plate was kept for about an hour on the forehead of a person when Darget was successful in find-

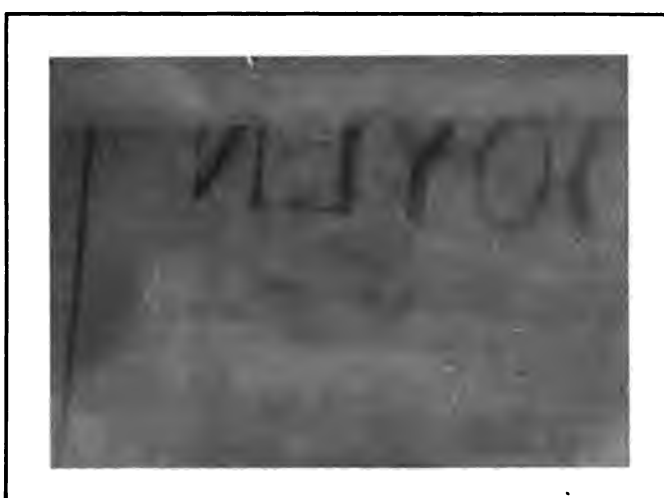

PHOTO PRODUCED BY EMANATION FROM THE BRAIN.

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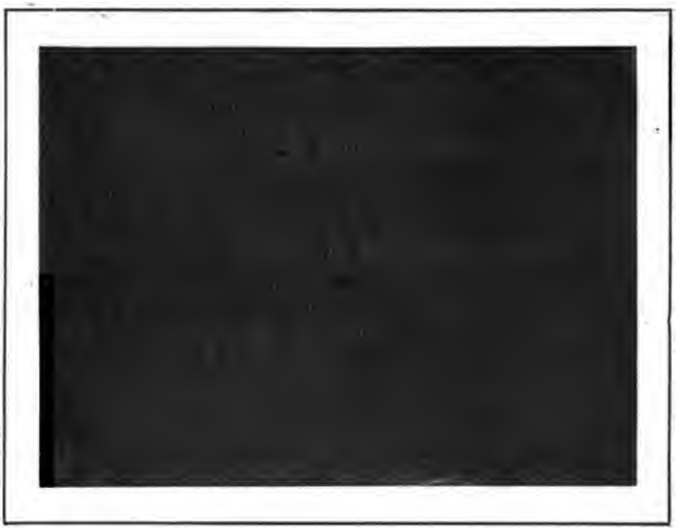
ing an impression on the plate protected by its triple envelope. In order, however, to supplement this demonstration, he inserted below the three covers a paper printed on one side—the white side being in contact with the sensitive plate—which gave a perfect photograph of the print.

The experimenter now handed a number of packages contained in a triple cover a photographic plate and print, to some of his acquaintances all of whom with some minor differences, obtained identical results. However, some of his subjects reproduced the printed words as positives and some as negatives, while with a few individuals, positive and negative reproductions were obtained on the same plate.



Another Print Obtained in Same Manner as the First.

In order to check those experiments, he then exposed the same paper with a plate surrounded by a triple cover to the full midday sun of August, without, however, obtaining the slightest reproduction. The fact that the plate on being developed became blackened somewhat more rapidly, only showed that the sunlight having penetrated the three covers, had exerted some action on the plate. Nor was he able in the shade, after a few hours' exposure, to obtain any reproduction as under the personal influence of subjects.

In connection with these experiments the gelatine side of the plate had always been turned towards the forehead of the person. When, however, the same experiments were repeated with the glass-side of the plate turned towards the forehead, the same phenomena of reproduction were observed.

On a suggestion by the celebrated physicist, Professor D'Arsonval, Darget then inserted metal films—gold, silver, tin, between the forehead and the plate, when the reproductions above referred to were replaced by strange images, resembling those of electrical discharges.

Darget, as above stated, ascribes those interesting phenomena to a vital fluidum, calling those rays "vital" rays or rays of life. He is inclined to think that the various parts of the body give out those rays to variable degrees of intensity and some further experiments, the results of which will shortly be made public, go to confirm this hypothesis.

This new radiation would thus constitute some agent inherent in living bodies, being as it were their immediate exterioration. These "rays of life" are variable according to the individual, that is, his character as well as his actual state of mind and health, thus being intimately connected with the very source of life.

Darget thinks his rays to be likely to furnish some valuable help to medical men in examining the mental state of a subject and possibly in the diagnosis of certain maladies. They will be applied experimentally at an early date.

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NEW ARMY SIGNALING DISCS

By J. HARTLEY KNIGHT

English Correspondent. TECHNICAL WORLD MAGAZINE.

LIEUT.-COL. B. R. DIETZ, of the 7th Dragoon Guards, who is now in Egypt, has invented a disc signaling apparatus which has attracted considerable attention in the British army. It is not claimed for the invention that it will supersede either the telephone or heliograph, but that it is a useful adjunct to both and will prove invaluable at times in the infantry-firing line and to the artillery, where it may not be found possible to use either telephone, heliograph or flags. The apparatus consists of a disc—about twelve inches in diameter—with a handle to it. On the disc is a semi-circular flap, which works on a spindle. The spindle is worked by a bolt action, so as to display a whole white or a whole black disc at the operator's will. The longs and shorts of the Morse code are made readable by changing from white to black, and *vice versa;* the white disc being displayed like the reflection of the sun in the mirror of the heliograph. Should the operator be signaling with a light background, such as the whitewashed wall of a farm house or a sky line, he can signal from black to white, or, in other words, the black face of the disc would take the place of the white. The reverse side of the disc—that is to say, the side which is held towards the enemy—is

HOW THE SIGNALING DEVICE CAN BE USED IN THE OPEN.

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painted or splashed with "invisible" colors and it is impossible to discern this side of the disc at fifty yards in grass, crops, roots, scrubs or among rocks, as long as it is held steady. The black and white side of the disc when the flap is being worked rapidly by the bolt, is very visible at long range. The constant change from black to white gives the movement, and the white does not mingle with the background. The disc is no larger than an ordinary soup plate, but can be read at a surprising distance with the naked eye, given good weather conditions. Under normal conditions it can nearly always be read at 2,000 yards with the naked eye, and has been so read at over 3,000 yards. With a service telescope in England the disc has been read at a distance of 6,000 yards. The picture of the two men shows how the disc may be used lying down and also the contrast when the flap is turned so as to show either a whole black or white disc; it also gives an idea of the invisibility at short range of the side which is intended to be held towards the enemy.

Lieut.-Col. Dietz has also patented an invention for signaling at night by means of an oval aluminum disc, the handle of which is hollow and contains, coiled up, about two and one-half yards of ordinary slow match—sufficient to keep burning from six to seven hours. The apparatus is so contrived that the burning end of the match is always kept in the center of the disc behind which is a small reflector. The match when burning shows a red cone, which in the dark looks exactly like a large burning cigar end. The darker the night the better it shows and it can be seen and read at a distance of about 200 yards. A secret code can easily be adapted for this mode of signaling. An indicating disc, which is intended to take the place of flags in the firing line, has also been patented by the same inventor. It consists of a canvas disc three feet in diameter, and is spread by means of two pieces of wire, which meet at the top of the pole and work on a pin through a notch in an aluminum ferrule. The canvas disc is so arranged that the device on the white ground can be changed from time to time. Thus the black bullseye may denote the 1st Infantry Brigade, while a disc with a black cross might denote the 2nd Infantry Brigade, and so on, giving an identifying device in each signal displayed.

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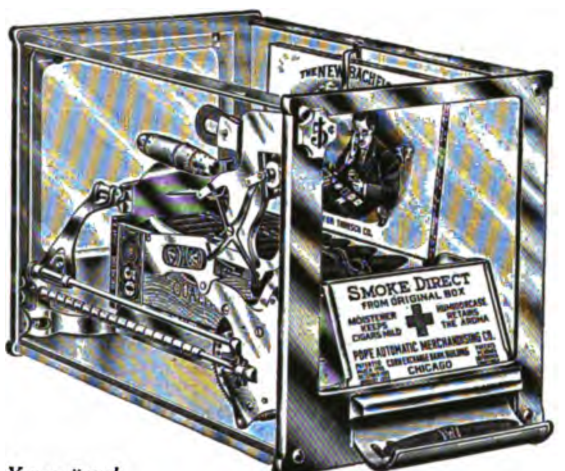

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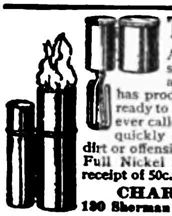

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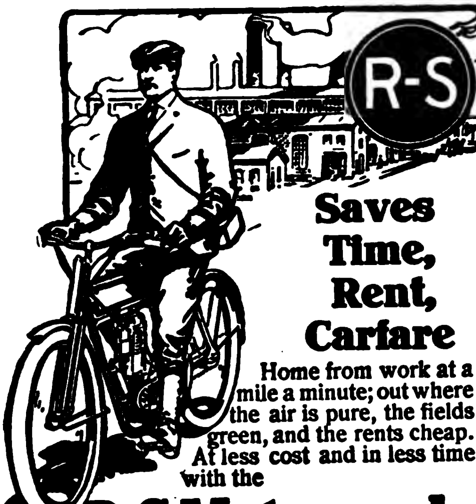

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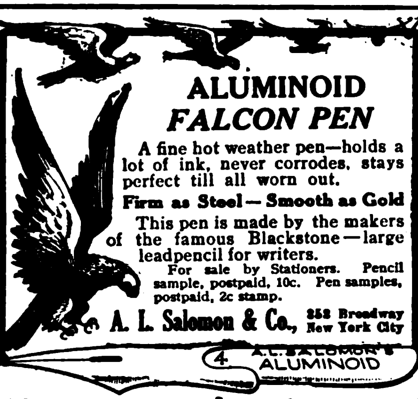

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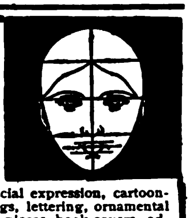

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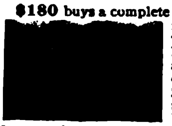

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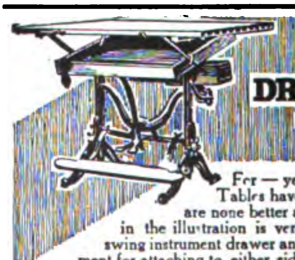

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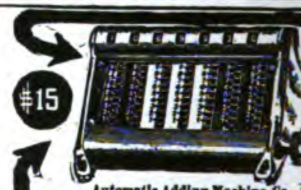

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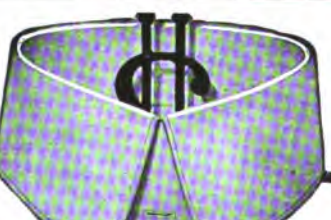

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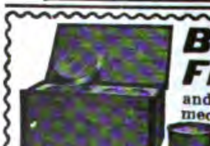

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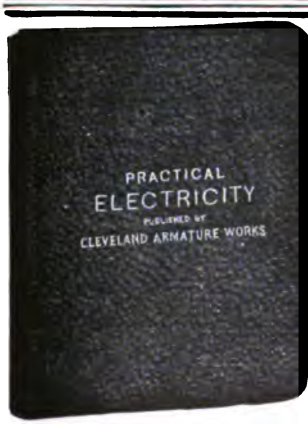

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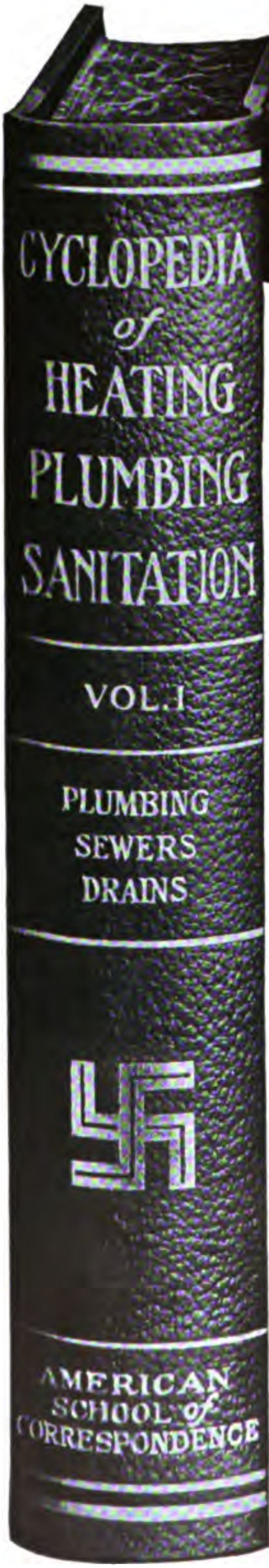

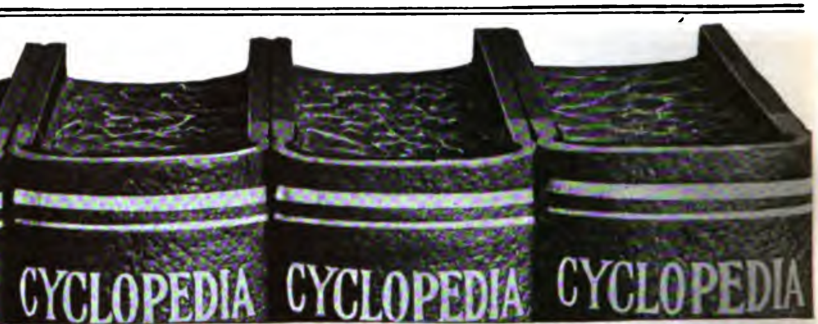

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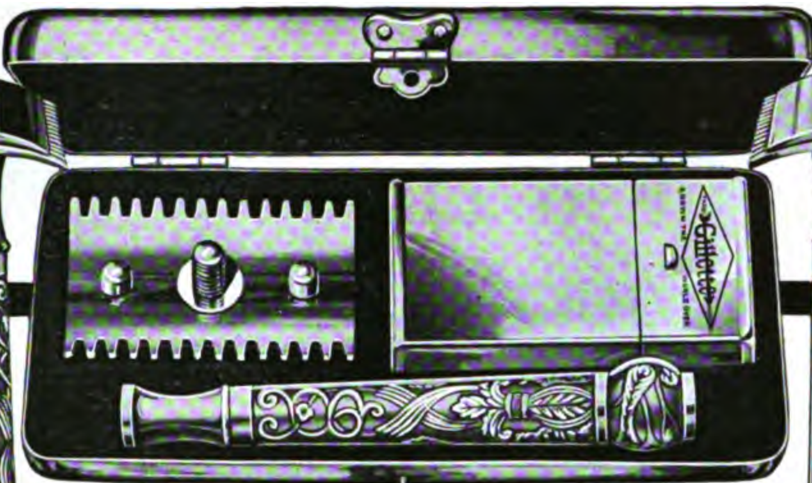

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